

PART II

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PART II

STREET DESIGN & CONSTRUCTION POLICIES

SECTION 1: STREET DESIGN & CONSTRUCTION POLICIES

1.1 Statement Of Policy

The criteria set forth in this section shall be considered minimum standards. The Town reserves the right to alter these standards for a given site when the change will best serve the interests of the public and the Town. All work shall be performed according to the following requirements. All standards are subject to interpretation by the Town Engineer.

1.2 Developer's Responsibility

It is the policy of the Town that developers shall be responsible for arterial road improvements adjacent to proposed sites. These responsibilities include (but are not limited to) dedication of future right-of-way and landscape tracts along major arterials bordering their site, paving and construction material testing costs, striping and signing. When required by the Town, the developer shall extend roadways to property lines for access by adjacent properties.

1.3 General

- A. It will be the policy of the Town to design roads on section lines as arterial streets.
- B. Collector streets are defined as having projected traffic volumes of 2500 vehicles per day or more.
- C. The Developer's engineer shall consider existing and future traffic flows when designing streets.
- D. All street construction shall conform to Town of Firestone standards and specifications. Any construction occurring two years after the plan approval shall require re-examination of the plans by the Town who may require that they be made to conform to standards and specifications current at that time.
- E. Street paving shall not start until the soils report and pavement design are approved by the Town, and subgrade compaction tests and proofrolls have been passed.
- F. When an existing asphalt street must be cut, the street must be restored to a condition equal to or better than its original condition. The Town shall document the existing street condition before any cuts are made. Patching shall be done in conformance with the Town of Firestone Standards. The finished patch shall blend smoothly into the existing surface. All large patches shall be paved with an asphalt lay-down machine. In streets where more than one cut is made, an overlay of the entire street width, including the patched area may be required. The Town shall make the determination of need for a complete overlay.

- G. Prior to the commencement of any construction, the Contractor shall contact all utilities to coordinate schedules.
- H. Prior to the commencement of any construction, the Contractor shall give the Town Clerk a minimum of 24 hours advance notice.

SECTION 2: DESIGN CRITERIA

2.1 Points Of Conflict

The spacing of intersections between arterials, collectors and residential streets is critical to maintaining safe driving conditions. Intersections of collector streets with arterial streets should be located at approximately 1/3-mile intervals. Intersections of residential streets with arterial streets should be located at approximately 1/4 mile intervals. Intersections of streets with arterial streets should be in line with streets intersecting on the opposite side. Streets intersecting on opposite sides of a residential or collector street should be directly across from each other or offset a minimum of 200 feet. Residential streets shall be designed to provide adequate circulation between collector streets. Intersections of arterials and residential streets should be minimized as much as possible.

2.2 Horizontal Alignment

Horizontal alignments of streets shall be based upon the following table:

HORIZONTAL ALIGNMENT								
<i>Street Type</i>	<i>Design Speed*</i>	<i>Minimum Centerline Radius</i>	<i>Minimum Tangent Between Curves or at Intersections</i>	<i>Minimum Corner Sight Distance (1)</i>	<i>Minimum stopping Sight Distance (2)</i>	<i>Minimum Super-Elevation Allowed (3)</i>	<i>Minimum Grade (4)</i>	<i>Maximum Grade</i>
Residential	30 mph	240 ft.	100 ft.	300 ft.	200 ft.	0	0.4%	8%
Collector	40 mph	610 ft.	150 ft.	400 ft.	275 ft.	0	0.4%	8%
Industrial/ Commercial	40 mph	610 ft.	150 ft.	400 ft.	275 ft.	0	0.4%	8%
Arterial	50 mph	1075 ft.	200 ft.	500 ft.	350 ft.	0.04 ft./ft.	0.4%	5%

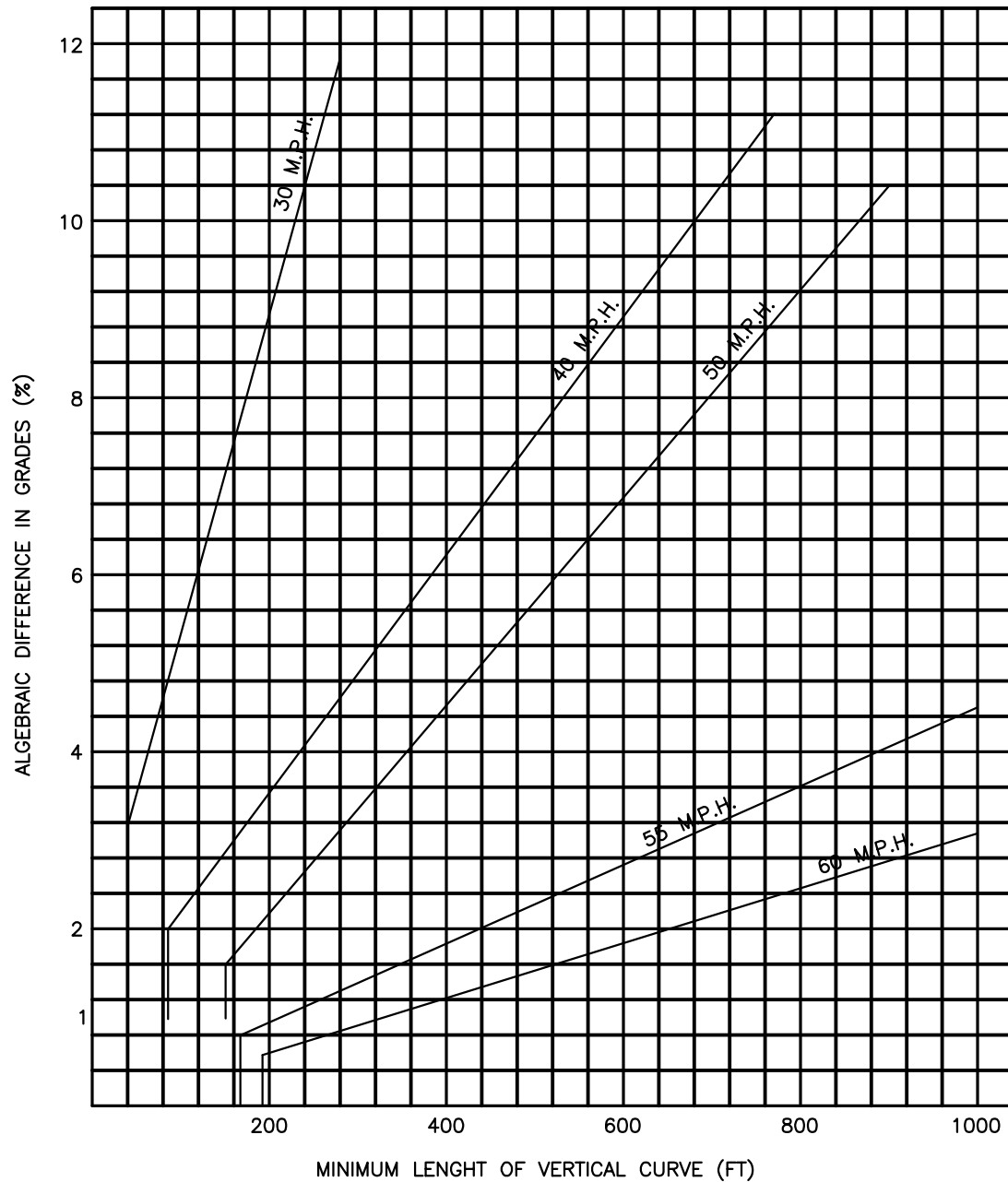
- (1) Corner sight distance measured from a point on the minor road, parallel to the roadway, 15 feet from the edge of the major road pavement, and from an eye height of 3.50 feet on the minor road to a height of object of 4.25 feet on the major road.
- (2) Stopping sight distance measured from the driver's eye, 3.50 feet above the pavement to the top of an object six inches high on the pavement anywhere on road.
- (3) On arterial streets with full super-elevation, the minimum centerline radius shall become 830 feet. Maximum change in cross slope shall be 1% in 25 feet.
- (4) Minimum grade shall apply to gutter flowline grade.

* *Lower design speeds may be used when existing conditions will not allow for 30 mph design speed for Residential or 40 mph design speed for Collectors and Industrial/Commercial if approved in writing by the Town prior to preliminary submittal.*

2.3 Vertical Alignment

- A. Figures E1 and E2 give minimum length of crest and sag vertical curves for various algebraic differences in grade. Streets designed in the Town of Firestone shall meet or exceed these minimums.

CREST VERTICAL CURVES



BASED ON AASHTO "GEOMETRIC DESIGN OF HIGHWAYS AND STREETS" 1984

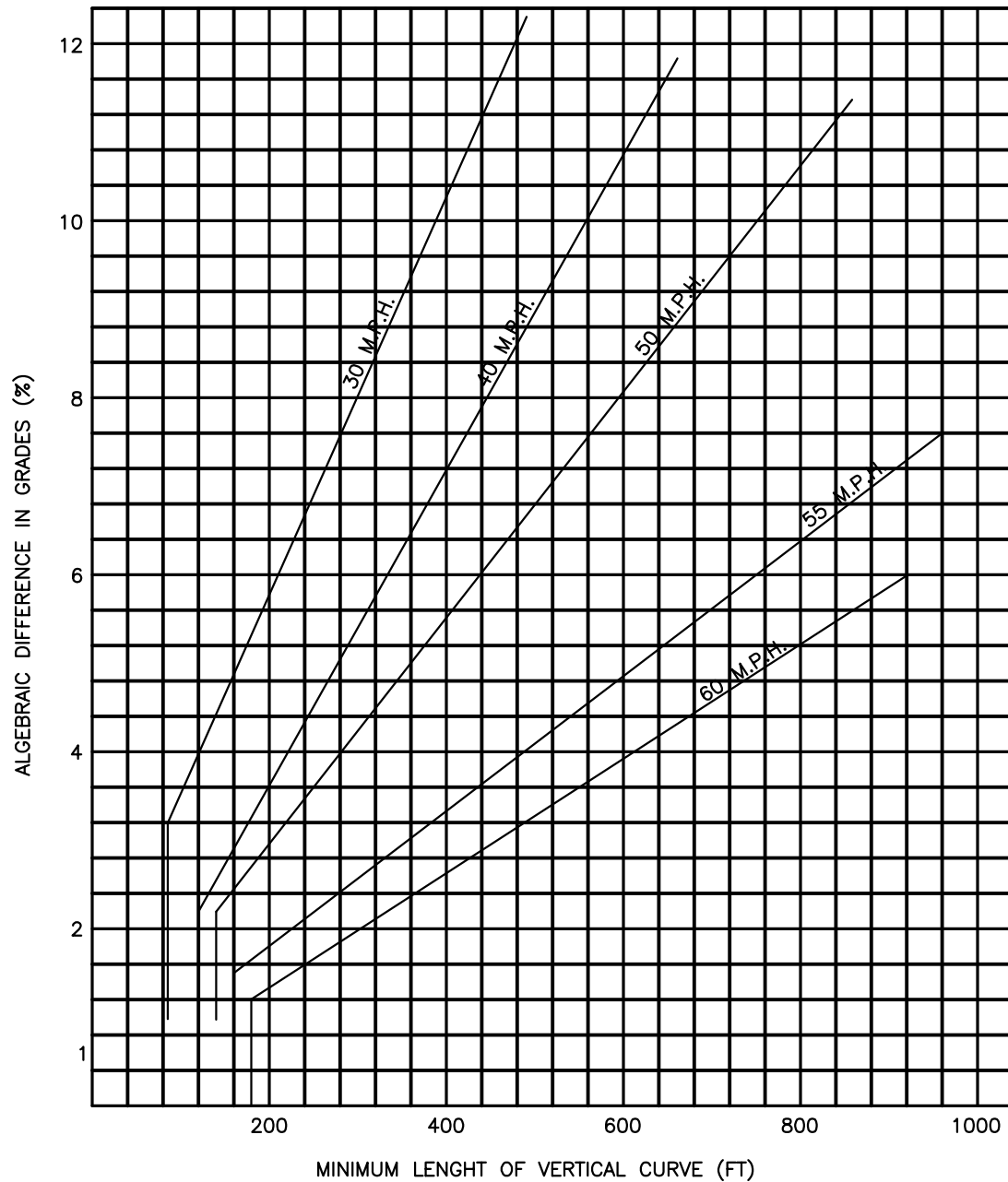
*TOWN OF
FIRESTONE*

FIGURE E1

APPROVED BY: MAYOR



SAG VERTICAL CURVES



BASED ON AASHTO "GEOMETRIC DESIGN OF HIGHWAYS AND STREETS" 1984

*TOWN OF
FIRESTONE*

FIGURE E2

APPROVED BY: MAYOR

TST

- B. Connection with existing streets shall be smooth transitions and existing grades shall be shown for at least 150 feet on all sides of the connection. The grade and ground lines of all streets that dead-end, except cul-de-sacs, shall be confined for 500 feet beyond the proposed construction. The grade and ground lines of all arterials shall be designed to continue 1000 feet beyond the end of proposed construction.
- C. Minimum length of vertical curves should be in accordance with Figures E1 and E2. The higher classified street at an intersection shall govern the through grade.
- D. For crest curves the street centerline and curb and gutter shall be constructed with vertical curves in accordance with Figure E1.
- E. For sag curves the street centerline should include a curve with minimum length as shown on Figure E2, for grade changes exceeding 0.4%. Curb and gutter should be constructed with no vertical curve in these areas. For grade changes larger than 0.40%, both street centerline and the curb and gutter shall be constructed with vertical curves in accordance with Figure E2. No single point grade break shall exceed 0.4%.
- F. The Design Engineer shall show centerline profiles (on utility drawings) through intersections and details at any mid-block crosspans to provide smooth riding transitions.
- G. The Design Engineer shall provide cross-sections to the construction limits at 100 foot intervals on arterial streets showing existing and proposed construction.
- H. Crown or cross slopes shall be no more than 4% or less than 2% measured from the crown to the lip of the gutter.

2.4 Intersections

- A. Approach grades at all intersections should not exceed 2.0%. The distance of approach grades shall be as follows:

1. Collectors intersecting arterials	125 feet
2. Collectors intersecting collectors	50 feet
3. Residential intersecting collectors	50 feet
4. Residential intersecting residential	50 feet
- B. Angle of intersection should be perpendicular but in no case more than 10°.
- C. Curb return radii shall be 20 feet for residential and collector streets, 25 feet on arterial streets, and 30 feet on major arterials.

2.5 Curb, Gutter & Sidewalk

- A. All streets shall have concrete curb and gutter.
- B. Arterial streets shall have vertical curb and gutter. Collector and residential streets may use either vertical curb and gutter or drive over curb and gutter.

- C. All streets shall have sidewalks. The minimum width of sidewalks shall be 4 feet for residential and collector streets and 5 feet for arterial streets.
- D. Arterial streets shall have detached sidewalks. Sidewalks shall adjoin the curb and gutter at all intersections.
- E. Collector streets may have either attached or detached sidewalks.
- F. Cross-pans shall be a minimum of 6 feet wide and (7/8) inch deep. Mid-block cross-pans shall be a minimum of 12 feet wide and (1 3/4) inches in depth.
- G. Minimum grade on cross-pans at flowline shall be 0.6%.
- H. Approaches to cross-pans should be in accordance with Part II, sections 2.2 and 2.3 of this manual.

2.6 Auxiliary Lanes

The necessity for auxiliary lanes bordering or within a new subdivision shall be determined by a traffic study. A registered professional transportation engineer must either prepare the report or have stamped the report. Background traffic from adjoining developments (if any) must be considered to anticipate future street system use. The developer shall be responsible for the cost of all additional auxiliary lanes needed to comply with the Town of Firestone access code.

2.7 On-street Parking & Driveways

All on street parking shall be in accordance with the cross section details shown at the end of Part II of this manual.

2.8 Medians & Street Lights

All medians shall be designed so that there is no interference with traffic flow. The nose of medians shall be a minimum of 10 feet behind the flowline of the intersected street. The minimum radius shall be 2 feet to flowline. Only outfall curb & gutter should be used to construct all medians unless otherwise approved by the Town engineer.

Residential streets and collector streets shall have RSL-350 lights with 70 watt high pressure sodium bulbs, 14 foot fiberglass poles, and 125 foot staggered spacing. The Developer shall make arrangements to have United Power install streetlights per these criteria. The Developer shall be responsible for all costs associated with the installation of streetlights. The Town may require alternative style lights at major intersections and along collector or arterial streets.

SECTION 3: PAVEMENT DESIGN

3.1 Geotechnical Study

The Town requires a geotechnical soil analysis for all proposed developments. A registered professional geotechnical engineer must either prepare or stamp the report. The report should

address subsurface soil conditions and classification, groundwater conditions, physical properties of the soils onsite, recommendations for basement, floor slab and footing requirements, analysis procedures, pavement sections (for each roadway classification) and any special earthwork or drainage specifications to be used onsite. Tests should be conducted on representative samples for the following properties; water content, dry density, swell-consolidation, unconfined compressive strength, grain size, plasticity index, R-value and water soluble sulfate content. In addition, because of the existence of mines in the vicinity of the Town of Firestone, a mine subsidence report may be required. This issue will be addressed on a site-specific basis.

3.2 Minimum Pavement Sections

Pavement design and materials shall be based on the soils properties onsite and AASHTO procedures and guidelines. The geotechnical report must include minimum pavement thickness for all the streets within the proposed development and adjacent arterial roadway improvements.

SECTION 4: STREET CUTS

4.1 Procedures

- A. Obtain a Right-Of-Way Work Permit from Town Clerk's office.
- B. Notify Town Clerk not less than 24 hours or more than 48 hours prior to the start of work.
- C. Erect traffic control prior to commencement of work.

4.2 Requirements

- A. Excavated material shall be stored in neat compact piles.
- B. Private driveways should be kept open whenever possible. Contractor shall notify the affected driveway owner 24 hours prior to commencing construction. If they must be closed, then closing should be as short and convenient a time as possible.
- C. No more than 200' of trench shall be open at one time.
- D. When traffic or conditions warrant, the Town may specify work hours.
- E. Two opposing lanes of traffic shall be maintained at all times unless approved on the permit by the Town Engineer.
- F. All street cuts shall be surfaced with an acceptable permanent pavement or a temporary hot or cold mix paving material immediately after completion of the backfilling operation and prior to the opening to traffic by the end of the work day. See Part V, Section 02575.
- G. The Contractor is responsible for maintaining the temporary patches deemed necessary by the Town.
- H. All asphalt or concrete removals shall be saw-cut or cut using an adequate cutting wheel on a grader or other heavy piece of equipment.

- I. All asphalt and concrete cuts shall extend a minimum of 2' beyond the limits of the trench.

4.3 Backfill

- A. Material will be free of rubbish, rocks, organic matter and large stones, pavement, frozen material, etc...
- B. Backfill placed will be compacted to a minimum density of 95% as determined by ASTM D 698-78 depending upon what layer is being compacted.
- C. Upon approval of the backfill, the surface shall be restored.

4.4 Gravel Surface

Alleys or streets which presently exist as gravel surfaces shall be replaced with CDOT Class 6 aggregate base course material one (1) inch greater in depth than what presently exists (minimum of 4") and to the line and grade of the existing gravel surface.

4.5 Bituminous Surface

- A. Subgrade and base material must be compacted to at least 95% of maximum density within $\pm 2\%$ of optimum moisture content as determined by ASTM D 698-78.
- B. Edges shall be saw cut straight with vertical faces.
- C. Tack coat existing asphalt/concrete edges.
- D. Asphalt pavement shall have a minimum full depth thickness of six (6) inches.
- E. The final lift of asphalt pavement shall not be placed in a lift greater than three (3) inches compacted, or less than two and one-half ($2\frac{1}{2}$) inches compacted.
- F. Asphalt content $5.8\% \pm 0.5\%$.
- G. Asphalt mix pavement temperature shall be between 234° and 325° F when placed and compacted.
- H. All asphalt pavements shall be compacted to at least 95% density as determined in accordance with ASTM D 2041-78, D 2726-83 and D 2950-82.
- I. Following placement of the asphalt surface, the joints where the new asphalt abuts the old shall be sealed with a fog or painted coat of bitumen cement.
- J. The permit holder who cuts the street shall be responsible for the workmanship and materials of such cut for a period of one (1) year.

4.6 Portland Cement Concrete Pavement

- A. Subgrade and base material must be compacted to at least 95% of maximum density within $\pm 2\%$ optimum moisture content as determined by ASTM D 698-78.
- B. Edges to be saw cut back a minimum of twelve (12) inches from the excavation with a full depth cut.
- C. Concrete pavement shall be replaced to the existing depth or a minimum of six (6) inches, whichever is greater.
- D. Minimum mix design of six (6) sacks of cement per cubic yard with an air content of $6\frac{1}{2}\%$ $\pm 1\frac{1}{2}\%$ by volume and shall have a minimum 28 day strength of 4000 psi.
- E. Concrete shall be protected from weather and rapid loss of moisture.
- F. Concrete shall be protected from vehicular traffic for a period not less than seven (7) days (two days with high/early concrete).
- G. Joints shall be cleaned and sealed with hot poured elastic type joint filler or an approved equal.
- H. Concrete patches shall be a minimum full lane in width and a minimum length of three (3) feet.

4.7 Bituminous Pavement With Concrete Base

- A. Subgrade and base material must be compacted to at least 95% of maximum density within $\pm 2\%$ of optimum moisture content as determined by ASTM D 698.
- B. Edges shall be cut back a minimum of twelve (12) inches from the excavation. Edges shall be straight with vertical faces.
- C. Tack coat existing asphalt/concrete edges.
- D. Asphalt pavement shall be the greater of six (6) inches or the existing pavement.
- E. The final lift of asphalt pavement shall not be placed in lifts greater than two and one-half ($2\frac{1}{2}$) inches compacted.
- F. Asphalt content $5.8\% \pm 0.5\%$.
- G. Asphalt mix pavement temperature shall be between 234° and 325° F when compacted.
- H. All asphalt pavement shall be compacted to at least 95% density as determined in accordance with ASTM D 2041-78, D 2726-83 and D 2950-82.

- I. Following placement of the asphalt surface, the joints where the new asphalt abuts the old shall be sealed with a fog or painted coat of bitumen cement.
- J. The concrete pavement shall be 1" greater than the existing thickness.
- K. The finished bituminous wearing surface shall not be placed on top of the concrete base for a period of two (2) days or until the compressive strength of the concrete is 2000 psi.
- L. The permit holder who cuts the street shall be responsible for the workmanship and materials of such cut for a period of one (1) year.

SECTION 5: TESTING

5.1 Material Testing

All materials used for infrastructure construction onsite are subject to testing at the discretion of the Town. In the case of testing failures, the specific material and corresponding structure will be removed and replaced. All testing must be done based on ASTM or AASHTO standards.

5.2 Developer's Responsibility

The developer is responsible for all costs associated with the testing of materials and the scheduling of such testing.

SECTION 6: INSPECTION

6.1 Procedures

Inspection will be completed by the Town for all proposed developments under construction. If a problem involving materials or workmanship is encountered the Town reserves the right to request testing be conducted. Prior to placement of any curb, gutter, sidewalk or pavement, the subgrade shall be properly compacted, tested and then proofrolled. Proofrolls shall be performed in the presence of the Town Inspector.

6.2 Contractor's Responsibility

The contractor shall be responsible for the workmanship and materials for a period of one (1) year from the issuance of final acceptance.

SECTION 02514

SIGNING, STRIPING, AND STREET MARKING

PART 1 - GENERAL

1.1 Description

This section covers materials and methods to be used for the installation of traffic control signs, lane striping, and street markings.

1.2 Quality Assurance

- A. All traffic control signs shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) with regard to sign type, size, location, and mounting specifications.
 - 1. All signs and posts will be supplied by the Town of Firestone.
- B. All striping and pavement markings shall comply with the MUTCD and Section 627 of the CDOT Construction Specifications.
 - 1. Striping shall be aligned with and parallel to the roadway. Alignment shall not vary more than 2" in 100' of roadway.

1.3 Submittals

- A. Provide a CDOT Certificate of Compliance (COC) of the epoxy striping material.
- B. Provide manufacturers certification that all of the thermoplastic marking material meets the requirements of AASHTO M 249 specification.

PART 2 - MATERIALS

2.1 Lane Striping Material

- A. Permanent Epoxy Striping Material
 - 1. Comply with CDOT Section 713.17.
 - 2. Permanent striping must be installed prior to Final Acceptance.
- B. Temporary Striping Material
 - 1. Comply with CDOT Section 708.05.
 - 2. Temporary striping may not be in service for more than 9 months.

2.2 Thermoplastic Pavement Marking Material

- A. Thermoplastic Marking Material
 - 1. Comply with CDOT Section 713.12.
 - 2. Use for STOP bars and cross walks only.
- B. Preformed Thermoplastic Material
 - 1. Comply with CDOT Section 713.14.
 - 2. Use for all symbols, numbers, and letters.

PART 3 - EXECUTION

3.1 Traffic Control Signs

- A. Signs shall be installed in the locations represented on the Drawings and in conformance with the MUTCD. Details for the orientation of the sign with respect to the edge of asphalt and the minimum height of the sign are included in the Drawings as well as in the MUTCD.
- B. Posts shall be buried at minimum of 2' and shall be concrete encased below grade. Posts shall be installed vertical both parallel to and perpendicular to the roadway. Post holes shall be at least twice the diameter of the posts to provide adequate concrete anchorage.

3.2 Epoxy Lane Striping

- A. Do not stripe until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the epoxy to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the epoxy material.
- C. Application methods shall comply with CDOT Section 627.05. Only an experienced applicator shall operate the equipment.
- D. Striping width shall be in conformance with the dimensions shown on the Drawings. Epoxy striping shall be applied to achieve a 15 mil minimum thickness. Application rate shall be between 100 s.f./gal (min.) and 110 s.f./gal (max.). Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.3 Thermoplastic Pavement Marking

- A. Do not apply until the final asphalt lift has cooled for at least 72 hours.

SECTION 7: HOT MIX ASPHALT PAVEMENT

1.1 Description

These specifications include general requirements applicable to all types of plant mixed hot mix asphalt pavements (HMAP). This work consists of one or more courses of asphalt mixture constructed on a prepared foundation in accordance with specifications. The design intent is to provide pavement with adequate thickness and quality to provide a serviceable life of 20 years. It is also the intent to provide construction in accordance with these specifications with a high standard of practice. This item shall include all labor, equipment, and materials to manufacture, place and compact asphalt cement concrete for pavement purposes.

TEST PROCEDURE DEFINITIONS	
CP - ##	Colorado Department of Transportation Testing Procedure
ASTM	American Society for Testing & Materials
AASHTO	American Association of State Highway & Transportation Officials
CP-L #####	Colorado Department of Transportation Lab Procedure

1.2 Materials

The hot mix asphalt shall be composed of a mixture of aggregate, filler, hydrated lime and asphalt cement. Some mixes may require polymer modified asphalt cement. Some mixes may allow up to 20% reclaimed asphalt pavement (RAP).

A. Aggregates

1. Aggregates for HMAP shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing. The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the following requirements:

Aggregate Test Property	Coarse: Retained on #4	Fine: Passing the #4
Fine Aggregate Angularity, CP-L 5113 Method A		
Traffic Level 1 & 2	-	40%
Traffic Level 3 to 5	-	45%
Two Fractured Faces, CP-45		
Top and Middle Lifts	80%	-
Bottom Lifts	70%	-
LA Abrasion, AASHTO T 96	45%	-
Flat and Elongated (Ratio 5:1) %, AASHTO M 283	10%	-
Adherent Coating (Dry Sieving) ASTM D 5711	0.5%	-
Sand Equivalent. AASHTO-T 176	-	45%

2. Reclaimed Asphalt Pavement material (RAP) shall be used only where specifically allowed and shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix. Mixes shall not contain more than 20 percent RAP.
3. The HMAP gradation for the Proposed Design Job Mix gradation shall be wholly within the control point gradation range set forth in the following Table. The allowable job mix gradation for production shall be the design job mix gradation with the tolerances of section 7.3 applied. The Proposed Design Job Mix and the final allowable job mix gradation for production shall report all sieve sizes listed in the following table:

GRADATION RANGE

(Percent by Weight Passing Square Mesh Sieves, AASHTO T 11 & T 27)

Mixture Grading Sieve Size	***SX (1/2" nominal)		S (3/4" nominal)		SG (1" nominal)	
	Control Points	Restricted *Zone	Control Points	Restricted Zone	Control Points	Restricted Zone
1 1/2"					100	
1"			100		90-100	
3/4"	100		90-100		@	
1/2"	90-100		@		@	
3/8"	@		@		@	
#4	@		@		@	39.5
#8	28-58	39.1	23-49	34.6	19-45	26.8-30.8
#16	@	25.6-31.6	@	22.3-28.3	@	18.1-24.1
#30	@	19.1-23.1	@	16.7-20.7	@	13.6-17.6
#50	@	15.5	@	13.7	@	11.4
*#200	2.0-8.0		2.0-7.0		1.0-7.0	

*The restricted zone is a guideline only. It is recommended that mix design gradations go above the restricted zone boundaries, on the "fine" side.

**These limits shall include the weight of lime at 1.0%.

***Limited to top mat on local/residential streets.

@These sieve sizes used only to determine the final allowable Job Mix Formula (JMF) in accordance with 7.3.

VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103) and Aggregate (T 84 & T 85), and calculated according to CP-48. All mixes shall meet the minimum VMA specified in the table on the following page:

MINIMUM VMA, %

Nominal Maximum Particle Size *	Air Voids **		
	3.5%	4.0%	4.5%
1"	12.5	13.0	13.5
3/4"	13.5	14.0	14.5
1/2"	14.5	15.0	15.5

*Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing size. The Nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

**Minimum VMA criteria apply to the mix design only. The minimum VMA criteria shall be linearly interpolated based on actual air voids. See Section 7.3 for tolerances.

B. Performance Graded Asphalt Binders – (Asphalt Cement)

1. The CONTRACTOR shall provide to the TOWN acceptable 'Certifications of Compliance' of each applicable asphalt cement grade from the supplier. Upon nonconformance with the specifications, the asphalt cement may be rejected as directed by the TOWN. When production begins, the CONTRACTOR shall, upon request, provide to the TOWN a sufficient amount to conduct the required tests. Larger aggregate mix designs require more material for testing, and in no case less than one gallon of each specified asphalt cement. Larger mixes (1" or larger) require at least two gallons. Additionally, when requested, the CONTRACTOR shall provide the refinery test results that pertain to the asphalt binders used during production
2. Asphalt Cement binder shall meet the requirements of the Superpave Performance Graded Binders (PG) as presented in the Table on the following page:

PROPERTIES OF PERFORMANCE GRADED BINDERS

Property	PG 58-28	PG 64-22	PG 76-28
Traffic Level: Recommended Usage	1 and 2	2 through 5	3 through 5
Flash Point Temperature, °C, AASHTO T 48	230 Min.	230 Min.	230 Min.
Viscosity at 135 °C. Pas, ASTM D 4402	3 Max.	3 Max.	3 Max.
Dynamic Shear, Temperature °C, where °C/Sin δ @ 10 rad/sec. \geq 1.00 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Rolling Thin Film Oven Residue Properties, AASHTO T 240			
Mass Loss, %, AASHTO T 240	1.00 Max.	1.00 Max.	1.00 Max.
Dynamic Shear, Temperature °C, where °G/Sin δ @ 10 rad/sec. \geq 2.20 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Elastic Recovery ¹ , 25 °C, % Min.*	N/A	N/A	50 Min.
Pressure Aging Vessel Residue Properties, Aging Temperature 100 °C AASHTO PP1			
Dynamic Shear, Temperature °C, where °G/Sin δ @ 10 rad/sec. \leq 5,000 Kpa, AASHTO TP 5	19 °C	25 °C	28 °C
Creep Stiffness, @ 60 sec. Test Temperature in °C, AASHTO TP 1	-18 °C	-12 °C	-18 °C
S, Mpa, AASHTO TP1	300 Max	300 Max	300 Max
m-value, AASHTO TP1	.300 Min.	.300 Min.	.300 Min.
**Direct Tension Temperature in °C, @ 1.0 mm/min., Where Failure Strain > 1.0%, AASHTO TP3	-18 °C	-12 °C	-18 °C

*Elastic Recovery by Task Force 31, Appendix B Method

**Direct tension measurements are required when needed to show conformance to AASHTO MP.1.

A. Additives – Hydrated Lime

- Lime shall be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200-mesh sieve shall not exceed 10% when determined in accordance with ASTM C 110. Drying of the test residue in an atmosphere free from carbon dioxide will not be required.

B. Tack Coat

- The emulsified asphalt, for Tack Coat shall be CSS-1h or SS-1h and conform to AASHTO M208 or M140, respectively.

2.1 Mix Design and Plant Produced Mixture Requirements

The mix design materials shall be those listed in Section 1.2 and used for the project. No substitutions are allowed during production.

- A. Grading SG (1-inch nominal aggregate) shall only be designed using the 150 mm Superpave molds. Hveem Stability and Lottmans are not required for Grading SG mixtures. Grading S and SX shall be designed using 100 mm Superpave molds when using the Superpave design method.

- 1. Marshall Mixture Design Method

Note: Only Superpave methods will be allowed starting July 2002.

- 2. Superpave Mixture Design Method

- a. The CONTRACTOR shall submit a Proposed Design Job Mix for each mixture required by the Contract. The design shall be determined using Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design. Guidance is provided in "Superpave Level 1 Mix Design" SP-2 published by the Asphalt Institute. Mix designs shall meet the requirements on the following page:

SUPERPAVE MIXTURE PROPERTIES

Traffic Level	0	1 & 2 & 3	4 & 5
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)	Non Vehicular or Paths	1) < 300,000 2) 300,000 to <1.0 Million 3) 1.0 to < 3.0 Million	4) 3.0 to 10.0 Million 5) > 10.0 Million
Initial gyrations, N _{initial} Air Voids, (For Information Only)	6	7	8
N _{initial} Air Voids, (For Information Only)	>8.5	>9.5	>11.0
Design gyrations, N _{design} (Air Void:3.5% to 4.5%) (See Note 1,2)	50	75	100
Hveem Stability CP- L 5106 (Grading S & SX only) (See Note 1,2)	N/A	28 Min.	30 Min.
Voids Filled with Asphalt, MS-2	70-80	65-78	65-75
Lottman, Tensile Strength Ratio, % Retained, CP-L 5109, Method B	80 Min.	80 Min.	80 Min.
Lottman, CP-L 5109 Dry Tensile Strength, psi	30 Min.	30 Min.	30 Min.
VMA %. CP-48 (See Notes 1,2)	Minimum VMA criteria applies to the mix design only (see table <i>STREET-14</i>). The minimum VMA criteria shall be linearly interpolated based on actual air voids.		

Note 1: Maximum Theoretical Specific Gravity of mix by CP-51.

Note 2: Refer to Section 7.3 for production tolerances.

2.2 Mixture Design Submittals

A. General Requirements

1. The CONTRACTOR shall submit all mixture designs, Certificates of Compliance, and laboratory data to the TOWN for approval at least 7 calendar days before construction is to begin. The mix design (Proposed Design Job Mix) must be approved by the TOWN prior to the start of construction.

2. Mixture Designs shall be performed in a materials laboratory under the direct supervision of and shall be stamped and signed by a Professional Engineer licensed in Colorado and practicing in this field. In addition, the CONTRACTOR shall submit, as part of the mixture design, laboratory data documents to verify the following:
 - Source of materials.
 - Gradation, specific gravity, source and description of individual aggregates and the final blend.
 - Aggregate physical properties.
 - Proposed Design Job Mix: aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content.
 - Mixing and compaction temperatures used.
 - Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
3. The TOWN reserves the right to verify the CONTRACTOR'S mix design for each hot asphalt pavement grading utilizing materials actually produced and stockpiled. If requested, the CONTRACTOR shall provide a sufficient quantity of each aggregate, mineral filler, RAP, and additive for the required laboratory tests, if required by the TOWN. The TOWN may request a Certificate of Conformance or Certificate of Compliance at any time on any material used.

B. Pre-paving Meeting

1. TOWN may require a pre-paving meeting of all parties involved in supply, haul, laydown inspection, quality control and quality acceptance of HMAP. Areas of responsibility and contact names and numbers should be shared.

3.1 Equipment

A. Mixing Plant

1. The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the HMAP.
2. Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the "Colorado Air Quality Control Act," Title 25, Article 7, CRS and regulations promulgated thereunder.
3. Acceptable safety equipment, approved by the TOWN, shall be provided by the CONTRACTOR to accommodate sampling of the mat in a minimum of 3 different areas and testing.

B. Hauling Equipment

1. Trucks used for hauling HMAP material shall have tight, clean, smooth beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.

C. Bituminous Pavers

1. Self-propelled pavers shall be provided for full lane width paving, and shall be equipped with a screed assembly, heated if necessary, capable of spreading and finishing the HMAP material in full lane widths applicable to the typical section and thickness shown in the Contract. Pavers used for shoulders, patching and similar construction, not requiring fine grade control, shall be capable of spreading and finishing courses of HMAP material in widths shown in the Contract.
2. The paver's receiving hopper shall have sufficient capacity for a uniform spreading operation and shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.
3. The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:
 - Ski-type device at least 30 feet in length
 - Short ski or short shoe
 - Adequate length of control line and stakes, if no other type of geometric control is present.
4. The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.
5. If the CONTRACTOR fails to obtain and maintain the specified surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made.
6. Placement of HMAP on a waterproof bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering.

3.2 Manufacture

A. Preparation of Aggregates

1. Heating and drying of the aggregates shall be accomplished without damaging the aggregate. Hydrated lime shall be added to achieve complete and uniform coating of the aggregate, in accordance with one of the methods on the following page:
 - Lime Slurry Added to Aggregate: The hydrated lime shall be added to the aggregate in the form of a slurry and then thoroughly mixed in an approved pug mill. The slurry shall contain a minimum of 70 percent water by weight.
 - Dry Lime Added to Wet Aggregate: The dry hydrated lime shall be added to wet aggregate (a minimum of three percent above saturated surface dry) and then thoroughly mixed in an approved pug mill.
2. The lime-aggregate mixture may be fed directly into the hot plant after mixing or it may be stockpiled for not more than 90 days before introduction into the plant for mixing with the asphalt cement. The hydrated lime may be added to different sized aggregates and stockpiled by adding 75 percent of the lime to the aggregate passing No. 4 sieve and 25 percent to the aggregate retained on the No. 4 sieve.

B. Mixing

1. The dried aggregates and asphalt cement shall be combined in the mixer in the quantities required to meet the design job mix. The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt cement is uniformly distributed throughout the aggregate. Baghouse fines shall be fed back to the mixing plant in a uniform and continuous manner to maintain uniformity in the mixture. The Baghouse, fines feeder, auger, and related equipment, shall be in recommendation. If the TOWN determines that non-uniform operation of the equipment is detrimental to the mixture, it may suspend all paving operations until the CONTRACTOR takes appropriate action.
2. The minimum temperature of the mixture when discharged from the mixer shall be as shown in the following table:

MIXTURE DISCHARGE TEMPERATURES

Asphalt Grade	Minimum Discharge Temperature	Maximum Discharge Temperature
PG 58-28	275 °F	305 °F
PG 64-22	290 °F	320 °F
PG 76-28	320 °F	350 °F

3. HMAP mix shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95 percent minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.
4. HMAP mix may be stored provided that any and all characteristics of the mixture are not altered by such storage. If storing or holding of the mixture causes segregation, excessive heat loss, or adversely affects the quality of the finished product, corrective action shall be taken. Unsuitable mixture shall be disposed of at the CONTRACTOR'S expense.
5. When placing hot bituminous mixture over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture, when rolling operations begin, shall be 250 degrees Fahrenheit. The job mix temperature may be increased up to 30 degrees Fahrenheit to obtain this temperature.

4.1 Tack Coat

- A. Prior to placement of HMAP, a tack coat shall be applied to all existing concrete and asphalt surfaces. The emulsified asphalt shall be diluted 1:1 with water and applied at 0.10 + or – 0.01 gallons per square yard of diluted material. The TOWN may direct other application rates to match the age of condition of the surface.
- B. The surface to receive the tack coat shall be dry and cleaned by sweeping, or another approved method, until dust, debris, and foreign matter are removed. The tack coat shall then be applied uniformly by squeegee, brooms, or distributor. Prior to paving, all water must have evaporated from the tack coat. Contaminated areas shall be cleaned and tack coat shall be reapplied.

5.1 Placement

- A. Hot Mix asphalt shall be placed only on approved, properly, constructed surfaces that are free from loose material, water, frost, snow, or ice. The hot mix asphalt and tack coat shall be placed in accordance with the temperature limitations of the table on the following page and only when weather conditions permit the pavement to be properly placed and finished as determined by the TOWN. Placement temperature as stated shall be increased by 5 degrees Fahrenheit for each 10 miles per hour wind velocity to a maximum increased minimum placement temperature of 70 degrees Fahrenheit.

**MINIMUM AIR AND SURFACE TEMPERATURES
LIMITATIONS FOR MIX PLACEMENT**

Compaction Layer Thickness	Top Layer of Pavement*		Lower Layers *	
	PG 58-28 PG 64-22	PG 76-28	PG 58-28 PG 64-22	PG 76-28
<2 inches (not recommended)	60 °F	75 °F	N/A	N/A
2 inches to <3 inches	50 °F	65 °F	40 °F	50 °F
3 inches or more - SG mix only	50 °F	50 °F	40 °F	40 °F

*Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base. The TOWN may not waive the above temperature limitations for PG 76-28.

- A. The mixture shall not be placed at a temperature lower than 245 degrees Fahrenheit for mixes containing PG 58-28 or PG 64-22 asphalt, and 290 degrees Fahrenheit for mixes containing polymer modified asphalt. Mix which is too cold or damaged by weather, will be rejected.
- B. The mixture shall be laid upon an approved surface, spread and struck off to obtain the required grade and elevation after compaction. The minimum lift thickness shall be at least three times (preferably four times) the nominal particle size. The mixture should be placed approximately 25 percent thicker than the existing surrounding mat thickness to account for compaction. Raking is discouraged and will not be allowed except to correct major problems of grade and elevation. Casting or raking that causes any segregation will not be permitted.
- C. On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screened, and luted by hand tools to the required compacted thickness plus 25 percent. Carefully move or minimally work the HMAP mix with the use of rakes, lutes, or shovels to avoid segregation. Mixtures made with modified asphalt cement require more rapid completion of handwork areas than for normal mixtures. Hauling and placement sequences shall be coordinated so that the paver is in constant motion. Excessive starting and stopping shall not be allowed. A construction joint shall be placed any time the paver stops, and the screed drops enough to cause a surface dip in violation of section 7.3, Surface Tolerances; or the mat temperature falls below that allowed in section 7.2, Compaction. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Echelon paving will be permitted.

6.1 Longitudinal Joints

- A. The longitudinal joints in both a new pavement and an overlay pavement layer shall offset the joint in the layer immediately below by a minimum of 6 inches. The joints in any pavement layer shall not fall in a wheel track or path. The joints in the top layer of new pavement, not built on top of an existing pavement, shall be located on lane lines, or as shown on the plans. Longitudinal joints shall be minimized, where feasible, with wide paving pulls or echelon paving. Joints shall not cross any centerline, lane line, or edge line unless approved by the TOWN. The CONTRACTOR shall submit, prior to paving, a joint plan and pavement marking plan showing locations and the methods to establish a field control line. The TOWN must approve such plans prior to paving. The CONTRACTOR shall use a continuous string line to delineate longitudinal joints during paving as shown on the joint plan. All string lines shall be removed at the end of each day's paving.
- B. The free edge of the paved pass shall be laid as straight as possible, to the satisfaction of the TOWN. This joint, if cold, shall be tack coated prior to placement of adjacent paving.
- C. The new compacted mat shall overlap the previously placed mat no more than 1.5 inches. Excess overlap or thickness shall not be raked or cast onto the new mat, but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will not be allowed to correct major grade problems or provide mix around manholes and meter covers. The longitudinal joint shall be rolled from the hot side and overlap the joint by approximately 6 inches on the cold side.

6.2 Transverse Joints

- A. The CONTRACTOR shall submit, prior to paving, a joint plan showing locations and the methods to be used to construct transverse joints. The TOWN must approve such plans prior to paving. Placing of the HMAP shall be continuous with a minimum of transverse joints, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of course. Tack coat material shall be applied to contact surfaces of all joints just before additional mixture is placed against the previously compacted material.
- B. The end of transverse joints shall be located so they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to support the roller on the downstream side of the joint. All tapered sections, rounded edges and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is restarted.
- C. When a tapered joint is required for traffic access, the ramp shall be removed back to a full depth from the segregated section before paving is restarted.

- D. When restarting paving operations, the paver screed shall be placed on the starter block on the completed side of the transverse joint. The starter block should be approximately 25% of the thickness of the existing completed mat, so that adequate grade and compaction can be achieved on starting the paving operation. The screed should be nulled (angle removed) when on starting blocks and an up angle of attack set. Proper head mix should be introduced into the paver prior to starting. The new compacted (downstream) side of the joint may be up to 3/16 inches higher than the old (upstream) side. Raking of this joint shall not be allowed except to correct major grade problems. The surface tolerance at the transverse joint must be verified with a 10-foot straight edge before the paver is more than 100 feet from the joint.

7.1 Segregation

- A. The asphalt mixture shall be transported and placed on the roadway without segregation. All segregated areas shall be removed immediately and replaced with specification material before the initial rolling. If more than 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been determined and corrected.
- B. The TOWN will visually determine areas that are segregated, and may also use density and gradation measures to help in this determination. The TOWN will visually determine the extent of the segregation. The CONTRACTOR will not be allowed additional compensation for correction of segregated areas.

7.2 Compaction

- A. The temperature of the mixture immediately behind the screed shall be at least 245 degrees Fahrenheit for PG 58-28 or PG 64-22 binder and 290 degrees Fahrenheit for PG 76-28 binder. The breakdown compaction shall be completed before the mixture temperature drops 20 degrees Fahrenheit.
- B. The HMAP shall be compacted by rolling. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density and surface texture while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continued until the required density is obtained. Final compaction shall be obtained using steel wheel rollers.
- C. If the required density is not achieved and the surface temperature falls below 185 degrees Fahrenheit, or there is obvious surface distress or breakage, no further compaction effort will be permitted unless approved by the TOWN. Price Reduction criteria in Section 76-28 asphalt cements shall be 235 degrees Fahrenheit. These minimum compaction temperatures may be adjusted according to the asphalt cement supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on other asphalt cement supplier documents, to be available on the job site. Pavement operations shall be suspended when density requirements are not met, and the problem shall be resolved prior to continuing paving operations.

- D. All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted on bridge decks.
- E. The CONTRACTOR shall establish a rolling pattern or procedure during the beginning of paving operations, which will achieve the required compaction and surface tolerances. This procedure may be re-evaluated by the CONTRACTOR and TOWN throughout the paving operations.
- F. All HMAP paving shall be compacted to between 92.0 and 96.0 percent of Maximum Theoretical (Rice) Density, (CP-51: Maximum Specific Gravity of Bituminous Paving Mixtures). The average (mean) of the 3 most recent production CP-51 Rice values shall be used in calculating Relative Compaction according to CP-44.
- G. The CONTRACTOR shall core the pavement, as required by the TOWN, for field density tests in accordance with Colorado Procedure 44, Method B (AASHTO T 230), or for field calibration of nuclear density equipment in accordance with the Appendix of Colorado Procedure 81 (ASTM D 2950). At a minimum, cores for nuclear density equipment calibration shall be taken at the beginning of placement of each pavement layer or change of mixture materials or gradation. Untested areas during placement will also require cores to be taken to verify compaction.
- H. Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.
- I. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture and compacted to conform with the surrounding area.

7.3 Production Tolerances

- A. The variation between any two contracts with the surface shall not exceed 3/16 inch in 10 feet for full lane width paving. For patching surface tolerances the variation shall not exceed 1/2" in 10 feet. Irregularities exceeding the specified tolerance shall be corrected at the CONTRACTOR'S expense. Transverse measurements for variations shall exclude breaks in the crown sections.
- B. Production test results that deviate from the design job mix by more than shown in the table on the following page are subject to conformity with job specific plans and specifications:

JOB MIX FORMULA TOLERANCES

Item	
Passing No. 3/8" and Larger ¹	± 6%
Passing No. 4 and No. 8	± 5%
Passing No. 30 to No. 50	± 4%
Passing No. 200 ²	± 2%
Air Voids	± 1.2%
VMA	± 1.2%
Hveem Stability	See footnote #3
Asphalt Content	± 0.3%
Asphalt Content, Mixes with >10% RAP	± 0.4%

1. There is 1.0 percent tolerance for the maximum sieve size.
 2. Mixes with passing No. 200 sieve material produced over 7.0 percent are allowed only when the above Air Voids and VMA tolerances are still met.
 3. Hveem Stability must meet the minimum value specified in Superpave Mixture Properties Table.
- C. When disagreements concerning determination of specification compliance occur, only valid tests from both the AGENCY and CONTRACTOR will be considered. The AGENCY shall determine validity. Generally, valid tests are those in which sampling and testing have been performed according to referenced procedures and the results are within stated precision statements. When disagreements occur with asphalt content and gradation tests results, solvent extracted aggregate testing shall take precedence over burnoff oven extracted aggregate, which shall take precedence over cold feed belt testing.

8.1 Sub-grade Preparation

- A. General:
1. Natural soils shall be stripped of organic matter, scarified, moisture treated and compacted by the Contractor prior to asphalt placement.
 2. The top one (1) foot of the sub-grade shall be moisture treated to between optimum and two (2) percent above optimum moisture content. The testing agent retained by the Contractor/Developer will perform the necessary tests to determine compliance with this provision.
 3. Soils shall be compacted to at least 95 percent of maximum standard Proctor dry density when tested in accordance with AASHTO T 99, Method A.
 4. Moisture treatment and compaction requirements shall also apply where additional fill is required to bring the subgrade to the required elevation.
 5. The subgrade shall be in a moist condition at the time the asphalt is placed.
 6. Asphalt shall not be placed on any portion of the subgrade which has not been tested for correct grade and cross-section.
 7. The subgrade shall be cleared of any loose material which may have fallen upon it.

8. All soft and unyielding material and other portions of the subgrade which will not compact readily when rolled or tamped shall be removed as directed and replaced with suitable granular material, placed and compacted as specified.
9. Proofroll inspections are required for all Town roadways prior to the placement of asphalt.
 - a. Valid for 24 hours – unless precipitation renders the inspection invalid.
 - b. Must be performed in the presence of a Town Inspector, Town Superintendent or Town Engineer.
 - c. Must be performed with a tandem axle truck that meets one of the following conditions: 1) a minimum 3,000 gallon water truck – fully loaded, or 2) a rear end dump truck having a minimum bed capacity of 8 cubic yards – fully loaded.

9.1 Soil Sterilization

- A. Prior to paving, an approved herbicide shall be applied at the rates and methods recommended by the manufacturer.
- B. Treatment shall be made at a temperature acceptable to the manufacturer.
- C. The Contractor shall comply with all Colorado statutes and all local ordinances or codes pertaining to the use and application of fungicides, insecticides, herbicides, or other agricultural chemicals.
- D. The Contractor will be held responsible for any damage to plant growth outside the designated treatment areas, where such damage is attributable to carelessness or improper application of the herbicide. Care shall be exercised to prevent powder spray or vapor drift which may damage crops, gardens, shrubs, or trees in the vicinity of the areas being treated.
- E. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.

END OF SECTION

SECTION 02514

SIGNING, STRIPING, AND STREET MARKING

PART 1 - GENERAL

1.1 Description

This section covers materials and methods to be used for the installation of traffic control signs, lane striping, and street markings.

1.2 Quality Assurance

- A. All traffic control signs shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) with regard to sign type, size, location, and mounting specifications.
 - 1. All signs and posts will be supplied by the Town of Firestone.
- B. All striping and pavement markings shall comply with the MUTCD and Section 627 of the CDOT Construction Specifications.
 - 1. Striping shall be aligned with and parallel to the roadway. Alignment shall not vary more than 2" in 100' of roadway.

1.3 Submittals

- A. Provide a CDOT Certificate of Compliance (COC) of the epoxy striping material.
- B. Provide manufacturers certification that all of the thermoplastic marking material meets the requirements of AASHTO M 249 specification.

PART 2 - MATERIALS

2.1 Lane Striping Material

- A. Permanent Epoxy Striping Material
 - 1. Comply with CDOT Section 713.17.
 - 2. Permanent striping must be installed prior to Final Acceptance.
- B. Temporary Striping Material
 - 1. Comply with CDOT Section 708.05.
 - 2. Temporary striping may not be in service for more than 9 months.

2.2 Thermoplastic Pavement Marking Material

- A. Thermoplastic Marking Material
 - 1. Comply with CDOT Section 713.12.
 - 2. Use for STOP bars and cross walks only.
- B. Preformed Thermoplastic Material
 - 1. Comply with CDOT Section 713.14.
 - 2. Use for all symbols, numbers, and letters.

PART 3 - EXECUTION

3.1 Traffic Control Signs

- A. Signs shall be installed in the locations represented on the Drawings and in conformance with the MUTCD. Details for the orientation of the sign with respect to the edge of asphalt and the minimum height of the sign are included in the Drawings as well as in the MUTCD.
- B. Posts shall be buried at minimum of 2' and shall be concrete encased below grade. Posts shall be installed vertical both parallel to and perpendicular to the roadway. Post holes shall be at least twice the diameter of the posts to provide adequate concrete anchorage.

3.2 Epoxy Lane Striping

- A. Do not stripe until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the epoxy to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the epoxy material.
- C. Application methods shall comply with CDOT Section 627.05. Only an experienced applicator shall operate the equipment.
- D. Striping width shall be in conformance with the dimensions shown on the Drawings. Epoxy striping shall be applied to achieve a 15 mil minimum thickness. Application rate shall be between 100 s.f./gal (min.) and 110 s.f./gal (max.). Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.3 Thermoplastic Pavement Marking

- A. Do not apply until the final asphalt lift has cooled for at least 72 hours.

- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.06. Only an experienced applicator shall operate the equipment.
- D. Application width shall be in conformance with the dimensions shown on the Drawings. Material shall be applied to achieve a 3/32" minimum thickness at the edges and 1/8" minimum thickness in the middle. Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.4 Preformed Thermoplastic Pavement Marking

- A. Do not apply until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.09. Only an experienced applicator shall operate the equipment.
- D. Application temperatures and heating methods recommended by the manufacturer shall be followed.

END OF SECTION

- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.06. Only an experienced applicator shall operate the equipment.
- D. Application width shall be in conformance with the dimensions shown on the Drawings. Material shall be applied to achieve a 3/32" minimum thickness at the edges and 1/8" minimum thickness in the middle. Ambient air temperature and pavement surface temperature shall be a minimum of 50° F for application.

3.4 Preformed Thermoplastic Pavement Marking

- A. Do not apply until the final asphalt lift has cooled for at least 72 hours.
- B. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
- C. Application methods shall comply with CDOT Section 627.09. Only an experienced applicator shall operate the equipment.
- D. Application temperatures and heating methods recommended by the manufacturer shall be followed.

END OF SECTION

SECTION 02235

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 Work Included

- A. Furnish and install aggregate base course consisting of one (1) or more courses of crushed aggregate on prepared subgrade.
- B. Related work specified elsewhere:
 - 1. Section 02220, Structure Excavation, Fills, and Embankment.
 - 2. Hot Mix Asphalt Pavement
- C. Applicable Publications:
 - 1. The term "State Specifications" in this Section refers to State Department of Highways, Division of Highways, State of Colorado "Standard Specifications for Road and Bridge Construction", 1991. Measurement and Payment sections of "State Specifications" do not apply.

1.2 Testing and Inspection

- A. Field Compaction Control:
 - 1. One (1) compaction test shall be performed for each 2,500 square yards of aggregate placed.
 - 2. ASTM D2922 (AASHTO T238): Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
 - 3. ASTM D1556 (AASHTO T191): Tests for Density for Soil in Place by the Sand Cone Method.
 - 4. ASTM D2167 (AASHTO T205): Tests for Density of Soil in Place by the Rubber Balloon Method.
 - 5. Compaction shall be to the following minimum densities, reference ASTM D698 or AASHTO T99, unless otherwise indicated:
 - a. Subgrade: 95%.
 - b. Aggregate Base Course: 95%.
 - 6. Moisture Content:
 - a. All compacted backfill shall be within 2% (\pm) of the optimum moisture content of the soil as determined by ASTM D698.
 - b. Water shall be added to the material, or the material shall be harrowed, disced, bladed or otherwise worked to insure a uniform moisture content, as specified.

- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Aggregate Base Course: No limit on greater thickness, but no more than 0.25" less than the thickness specified.
- C. Surface Smoothness: Test finished surface of aggregate base course for smoothness using 10' straight edge applied parallel with, and at right angles to, centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
 - 1. Aggregate Base Course: 0.25".
- D. Proof rolling is required as specified above.

1.3 Submittals

- A. Submit test results for each source of material.
 - 1. Provide for the following:
 - a. Gradation.
 - b. Los Angeles wear test.
 - c. Aggregate quality.
 - d. Liquid limits.
 - e. Plasticity index.
 - 2. Perform soil compaction tests, ASTM D698 or AASHTO T99, Standard Method of Test for Moisture Density Relations of Soils using a 5.5 lb. Rammer and a 12" drop.
 - a. Use method A, B, C or D as appropriate, based on soil condition and judgement of the testing laboratory.
 - b. Sample tests will be representative of materials to be placed.
 - c. Determine and provide maximum density curve for each type of material encountered or utilized.
 - d. Include Atterberg Limits, gradation and specific gravity.
 - 3. Provide a density test of a typical sample.
 - 4. Test results will be basis for field quality control.

1.4 Job Conditions

- A. Drainage and Ground Water:
 - 1. Maintain excavations free from water during construction.
 - 2. Remove water encountered during construction to the extent necessary to provide a firm subgrade and remove standing water.
 - 3. Divert surface runoff or use other means necessary to accomplish the above.

- B. Weather:
1. Do not construct aggregate base course during freezing weather.
 2. Do not place on frozen surfaces.
 3. Do not place frozen materials, snow or ice in aggregate base course.
 4. Do not deposit, tamp, roll or otherwise mechanically compact in water.
- C. Scarify surface, reshape and compact to required density, completed or partially completed areas of work disturbed by subsequent construction operations or by adverse weather.

PART 2 - PRODUCTS

2.1 Aggregate

- A. Crushed stone or crushed gravel conforming to Section 703.03 of "State Specifications".
- B. Gradation: Class 6 of Section 703.03 of "State Specifications" with an "R" value between 70 and 77.

PART 3 - EXECUTION

3.1 Subgrade

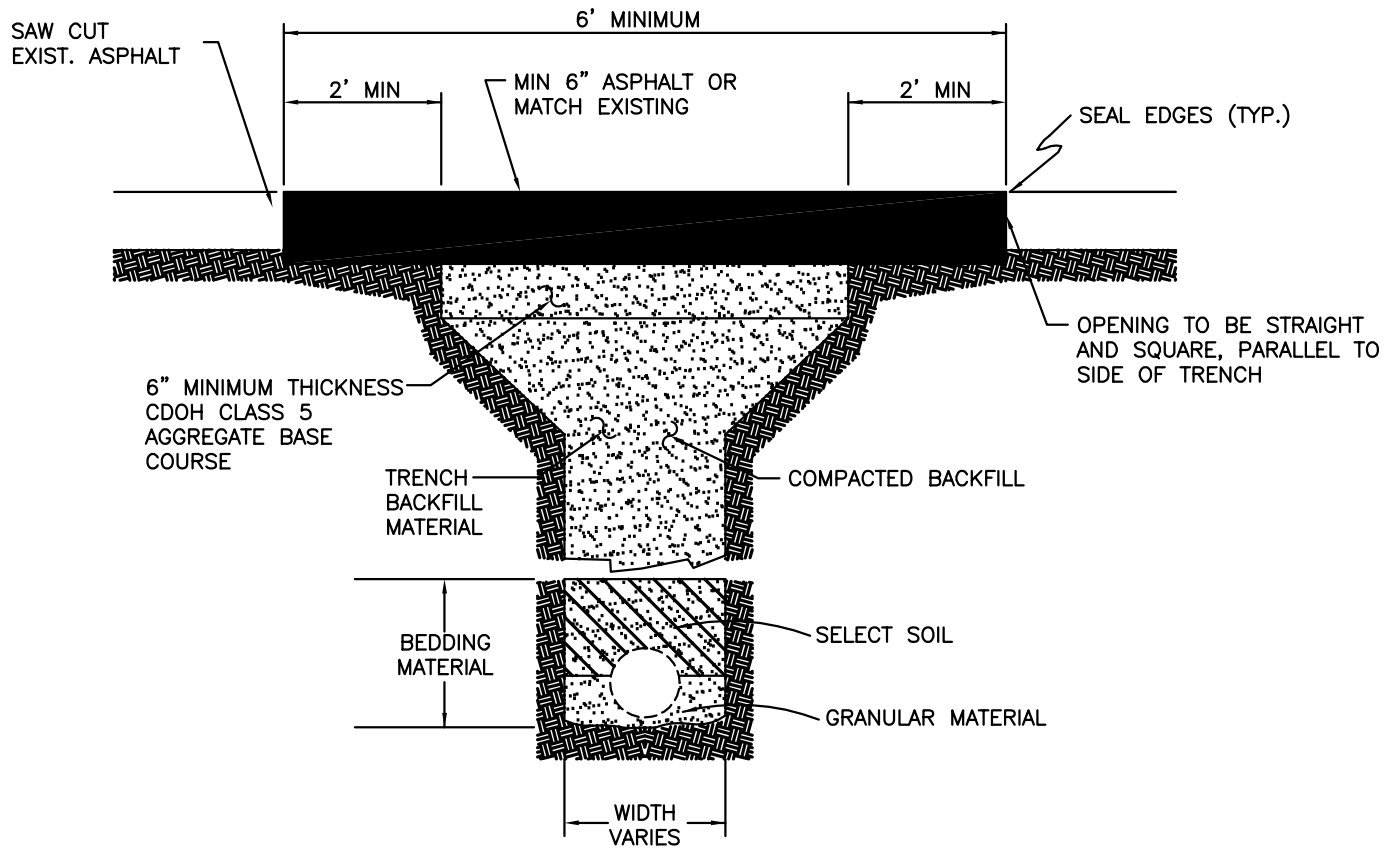
- A. Scarify to a depth of 6" and compact. Not required if existing subgrade has been recycled.
- B. Remove exposed cobbles, stones or boulders greater than 6" in size that create an irregular surface at subgrade.
- C. Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense and intact.
- D. Level and roll subgrade so that aggregate base course will be compact and bond well with the subgrade.
- E. Proof rolling is required for subgrade for areas to receive aggregate base course. Proof roll with a heavy rubber tired roller. Proof rolling shall be done after the specified compaction has been obtained. Areas found to be weak and those areas which fail a proof roll shall be ripped, scarified, wetted or dried as necessary and recompacted to the required density and moisture. The operating weight of the roller shall be not less than 12 tons per wheel. Tires shall be inflated to a minimum pressure of 70 lbs. per square inch. Repeat proof rolling testing until all areas to be paved have passed the proof rolling tests.

3.2 Installation

- A. Maximum compacted thickness of one (1) layer not to exceed 6".

- B. Proof rolling is required for aggregate base course to receive pavement. Proof roll with a heavy rubber tired roller. Proof rolling shall be done after the specified compaction has been obtained. Areas found to be weak and those areas which fail a proof roll shall be ripped, scarified, wetted or dried as necessary and recompact to the required density and moisture. The operating weight of the roller shall be not less than 12 tons per wheel. Tires shall be inflated to a minimum pressure of 70 lbs. per square inch and a maximum pressure of 90 lbs. per square inch. Repeat proof rolling testing until all areas to be paved have passed the proof rolling tests.

END OF SECTION



1. BEDDING MATERIAL SHALL EXTEND A MINIMUM OF 12-INCHES ABOVE TOP OF PIPE.
2. GRANULAR MATERIAL SHALL BE A MINIMUM OF 4-INCHES BELOW PIPE INVERT.
3. PRIOR TO INSTALLATION OF PATCH, ALL EDGES OF EXISTING ASPHALT SHALL HAVE A TACK COAT APPLIED.
4. ALL SEAMS BETWEEN NEW AND EXISTING PAVEMENT SHALL BE SEALED WITH AN ASPHALT TACK COAT.
5. PAVEMENT SECTION SHALL MATCH EXISTING OR 6" ASPHALTIC CONCRETE WHICHEVER IS GREATER.
6. REFERENCE STANDARD STREET SPECIFICATIONS.
7. THE TOWN SHALL, AT ITS SOLE DISCRETION, REQUIRE FLOWABLE FILL IN LIEU OF COMPACTED BACKFILL ON A CASE-BY-CASE BASIS.

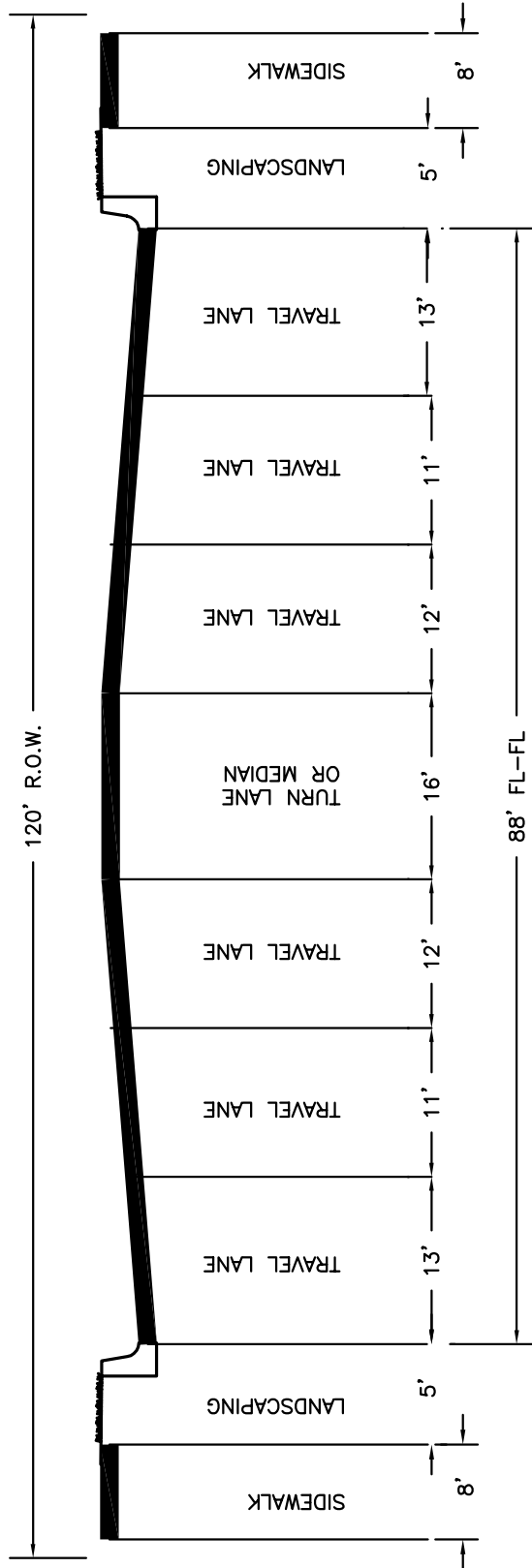
*TOWN OF
FIRESTONE*

*STREET CUT UTILITY
TRENCH DETAIL*

APPROVED BY: MAYOR

TST

*MAJOR ARTERIAL
(6 LANES)*



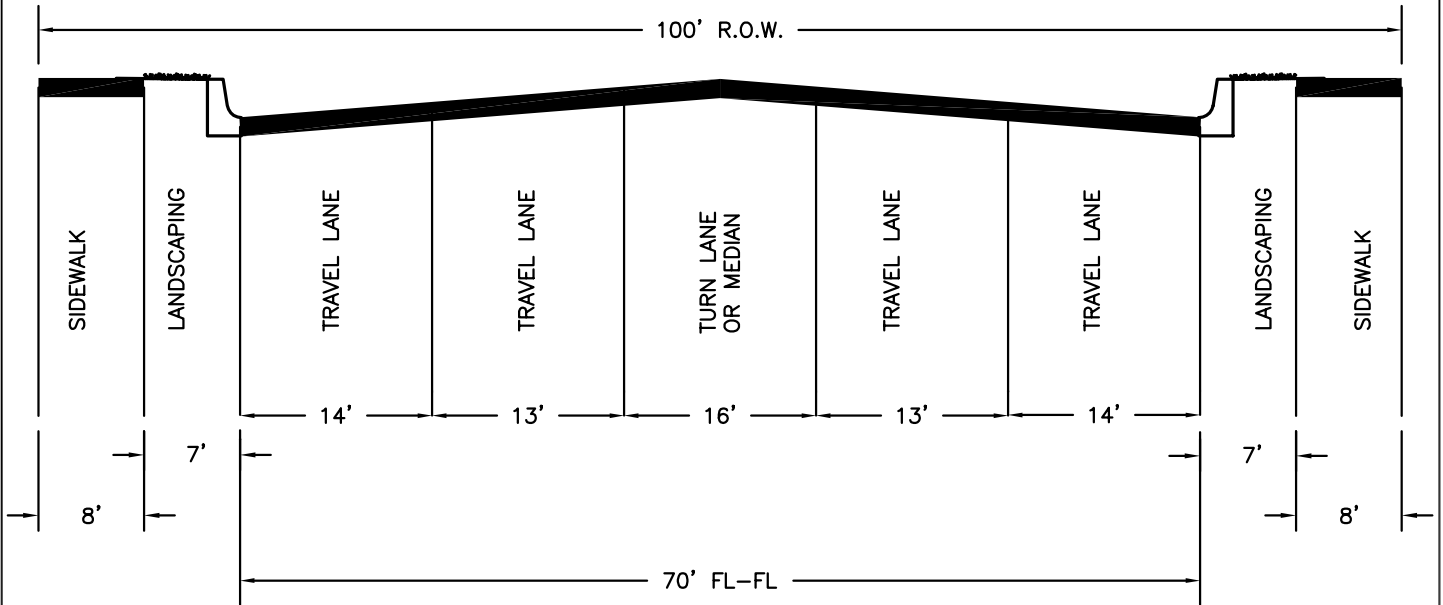
*TOWN OF
FIRESTONE*

*MAJOR ARTERIAL
STREETS*

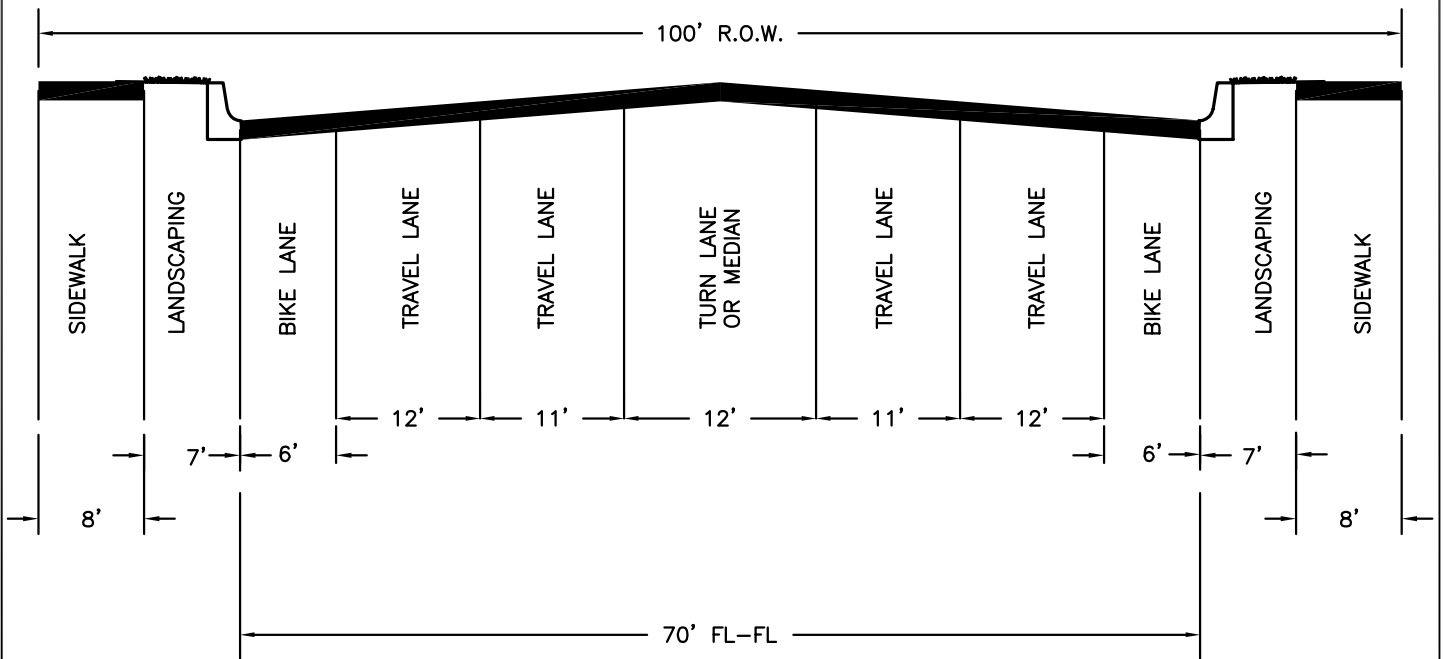
APPROVED BY: MAYOR

TST

ARTERIAL (WITH NO BIKE LANES)



ARTERIAL (WITH BIKE LANES)



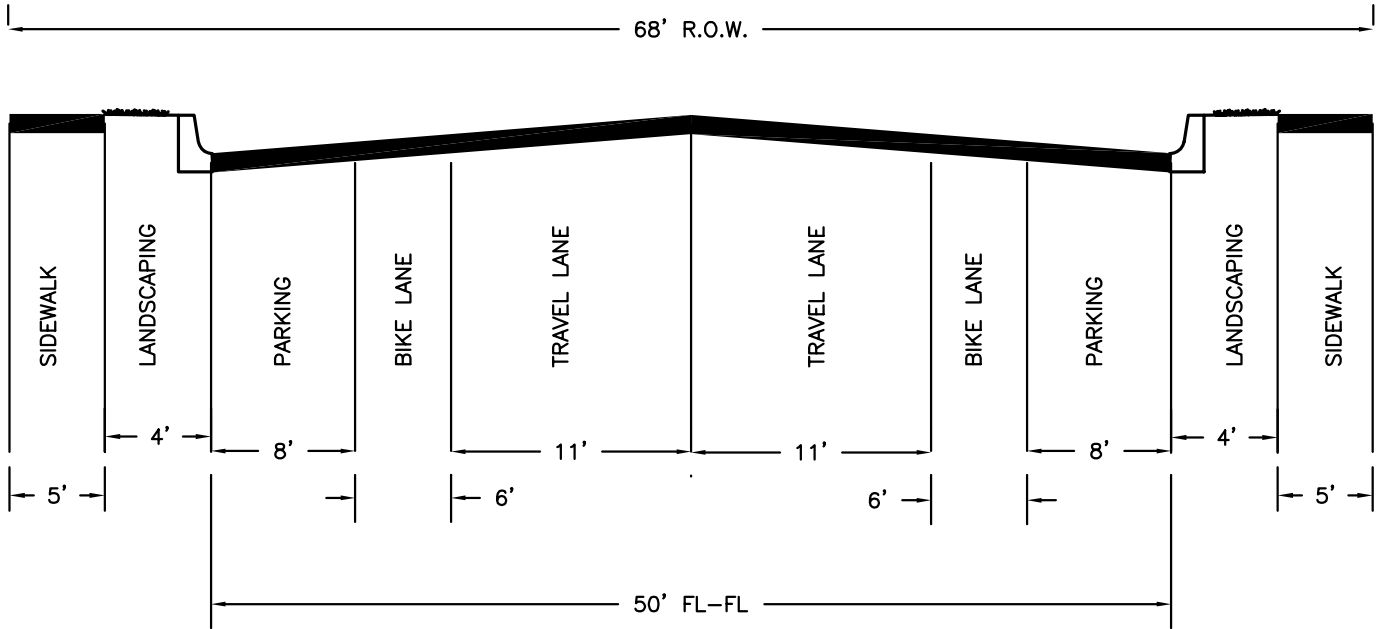
*TOWN OF
FIRESTONE*

*ARTERIAL
STREETS*

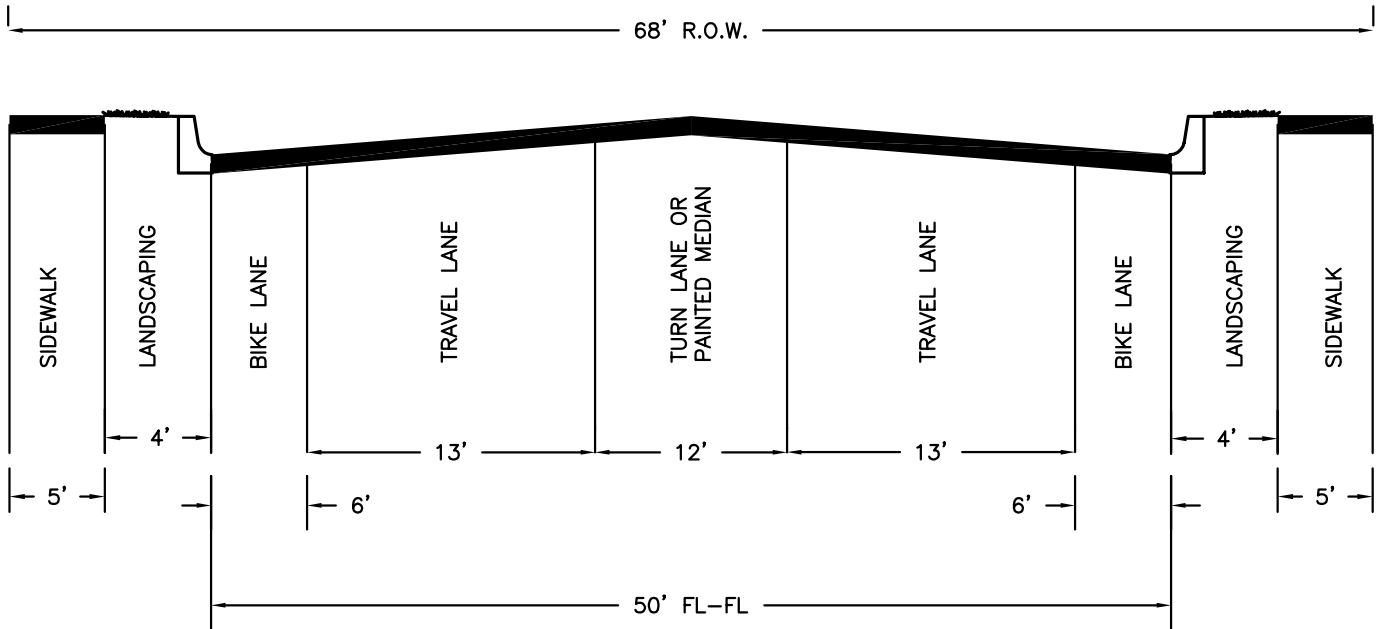
APPROVED BY: MAYOR

TST

COLLECTOR (WITH ON STREET PARKING)



COLLECTOR (WITH NO ON STREET PARKING)



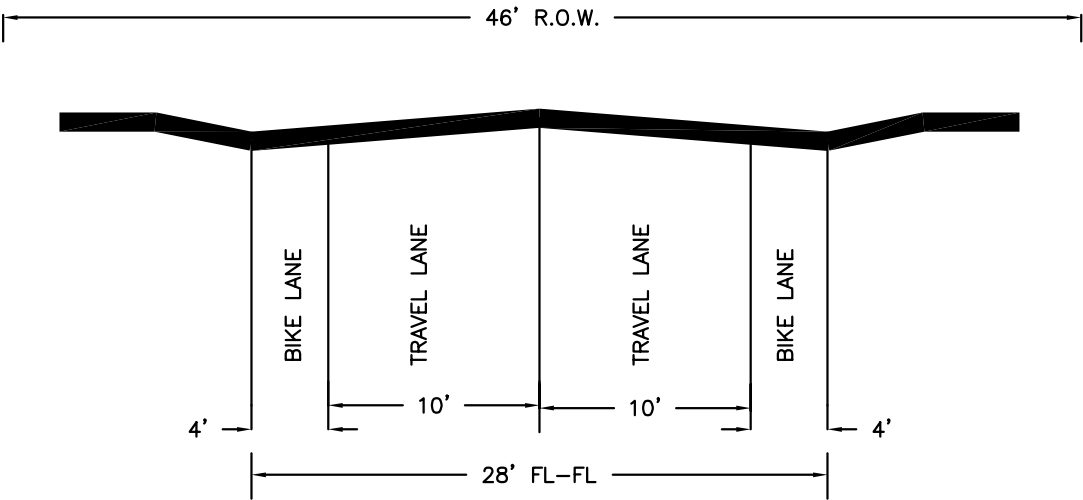
*TOWN OF
FIRESTONE*

*COLLECTOR
STREETS*

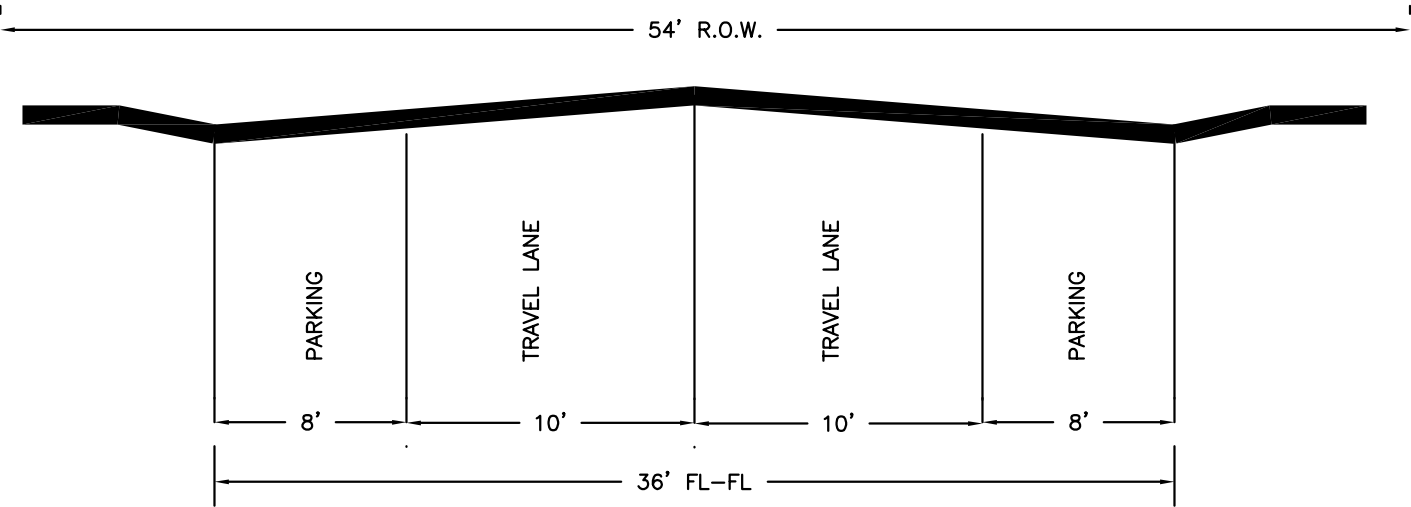
APPROVED BY: MAYOR

TST

*RESIDENTIAL
(NO ON-STREET PARKING)*



*RESIDENTIAL
(WITH PARKING)*



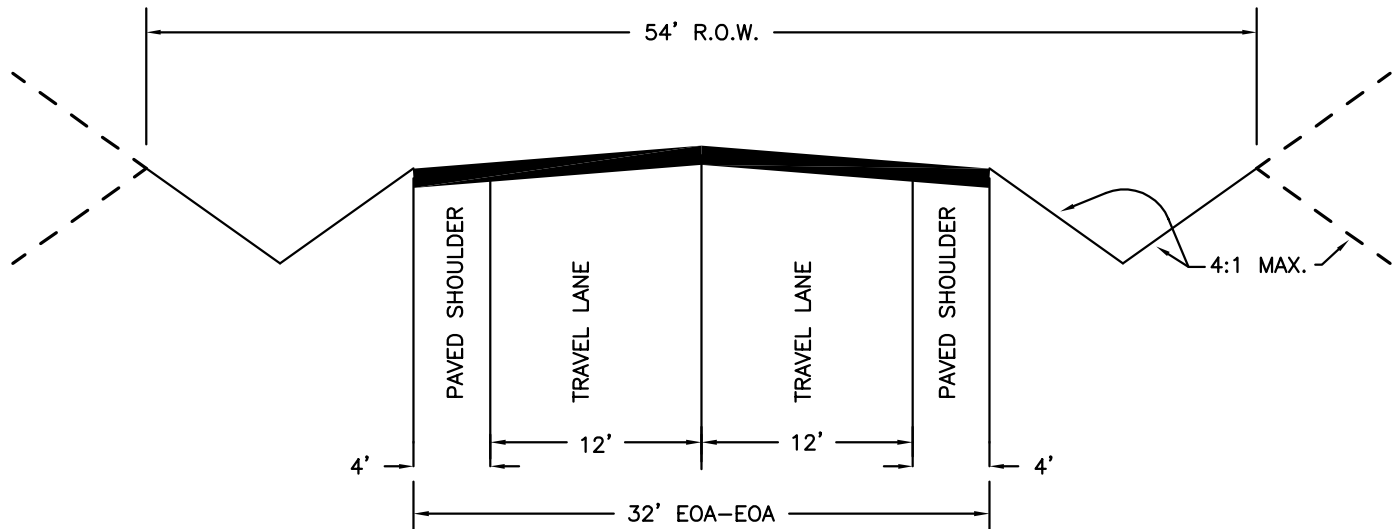
*TOWN OF
FIRESTONE*

*RESIDENTIAL
STREETS*

APPROVED BY: MAYOR



*RURAL
(BY SPECIAL APPROVAL ONLY)*



RURAL STREETS SHALL ONLY BE APPROVED UNDER THE FOLLOWING CONDITIONS:

1. VEHICLE TRIP COUNT IS LESS THAN 150 TRIPS PER DAY;
2. STREET IS INTERNAL TO THE SUBJECT PROPERTY AND WILL NOT SERVE ANY OTHER PROPERTY;
3. SUBJECT PROPERTY IS LOCATED ON THE FRINGE OF THE TOWNS GROWTH AREA;
4. LOTS ON THE SUBJECT PROPERTY ARE A MINIMUM OF 1.0 Ac. IN SIZE;
5. DRIVEWAY LENGTHS WILL ACCOMMODATE NO ONSTREET PARKING;
6. CENTERLINE PROFILE SLOPES WILL NOT EXCEED 4.0%;
7. ROADSIDE DITCH WILL CONVEY RUNOFF FROM THE 2-yr STORM AT 2.0 FPS OR GREATER VELOCITY
8. ARRANGEMENTS FOR MAINTENANCE OF THE ROADSIDE DITCH ARE ACCEPTABLE TO THE TOWN;
9. APPLICANT CAN SHOW PEDESTRIAN TRAFFIC WILL BE ACCOMMODATED;
10. OTHER CONDITIONS MAY BE REQUIRED BY THE TOWN WHEN IN THE BEST INTERESTS OF THE PUBLIC.

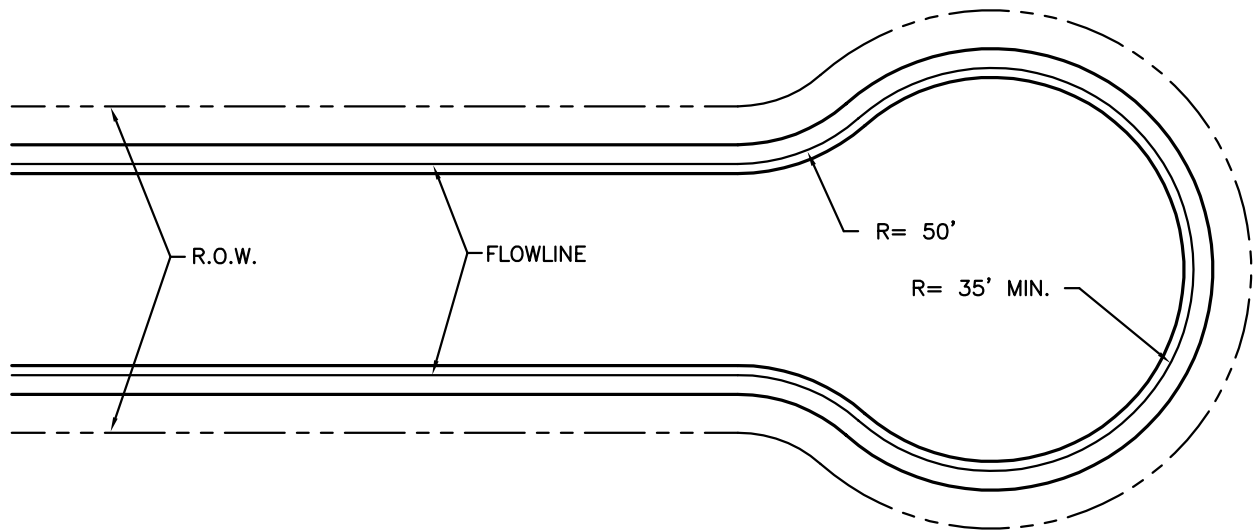
*TOWN OF
FIRESTONE*

*RURAL
STREETS*

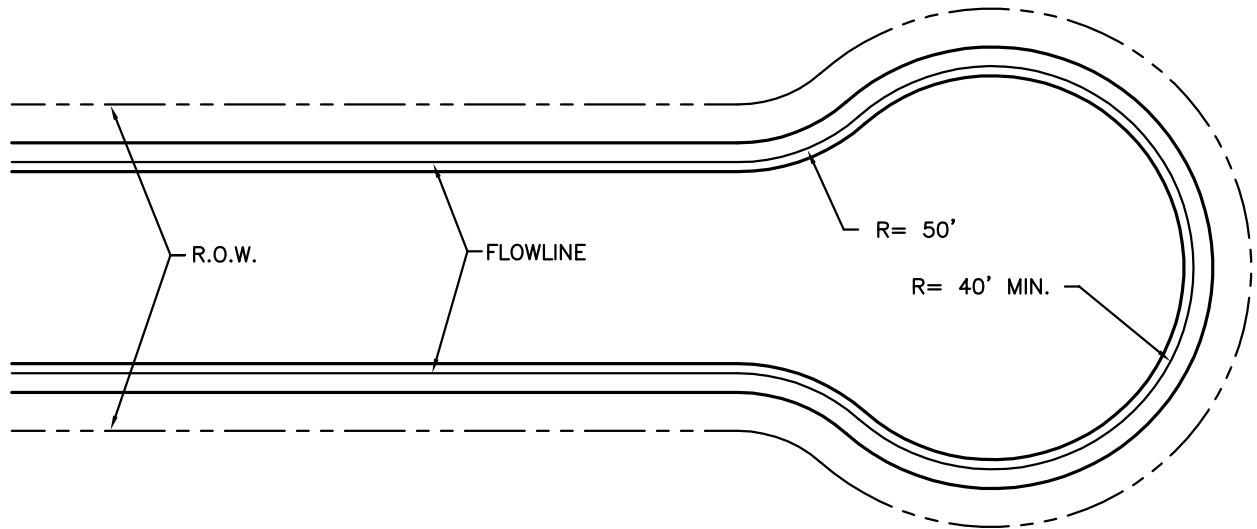
APPROVED BY: MAYOR

TST

DRIVE-OVER CURB AND GUTTER



VERTICAL CURB AND GUTTER

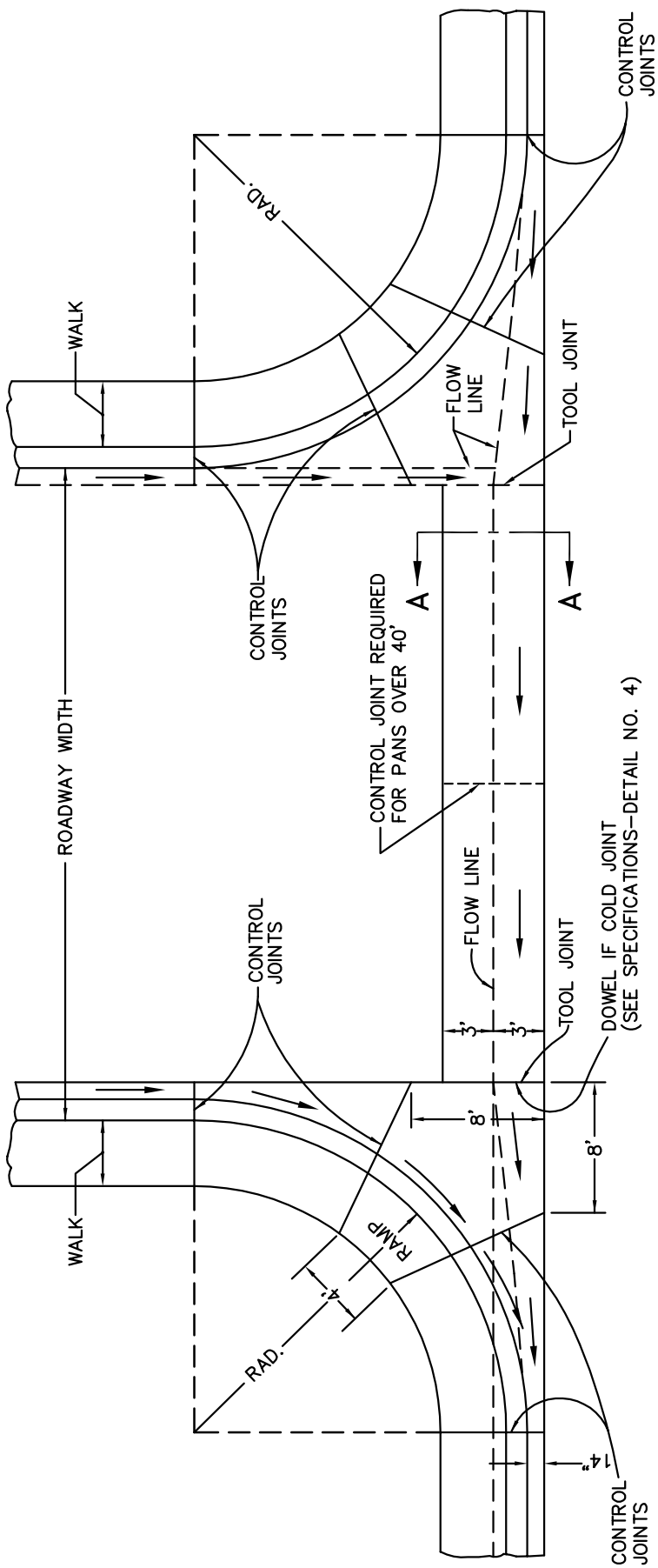


*TOWN OF
FIRESTONE*

CUL-DE-SAC

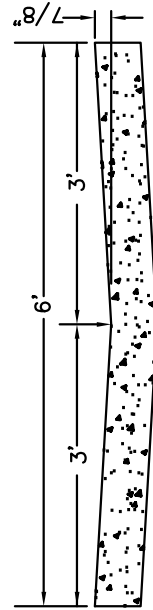
APPROVED BY: MAYOR

TST



NOTES:

6' WIDE PAN FOR RESIDENTIAL STREETS.
 8' WIDE PAN FOR COLLECTOR AND ARTERIAL STREETS.
 ALL INTERSECTIONS TO HAVE ACCESS RAMPS



SECTION A-A

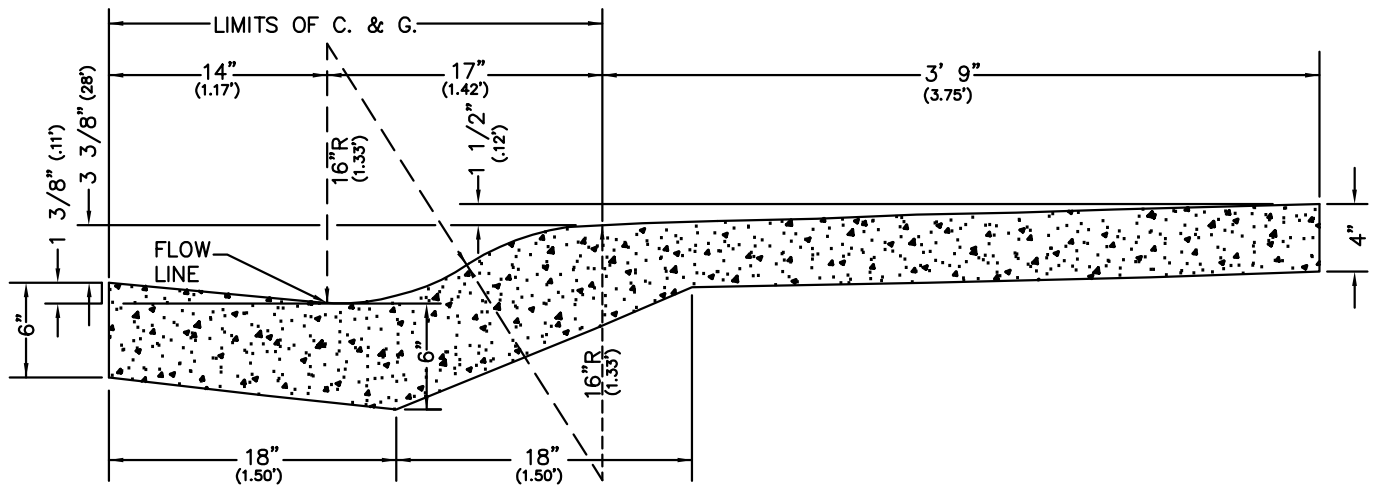
* 8" MIN. ON RESIDENTIAL
 USE CONCRETE PAVEMENT DESIGN
 + 1/2" FOR COLLECTOR & ARTERIALS

**TOWN OF
 FIRESTONE**

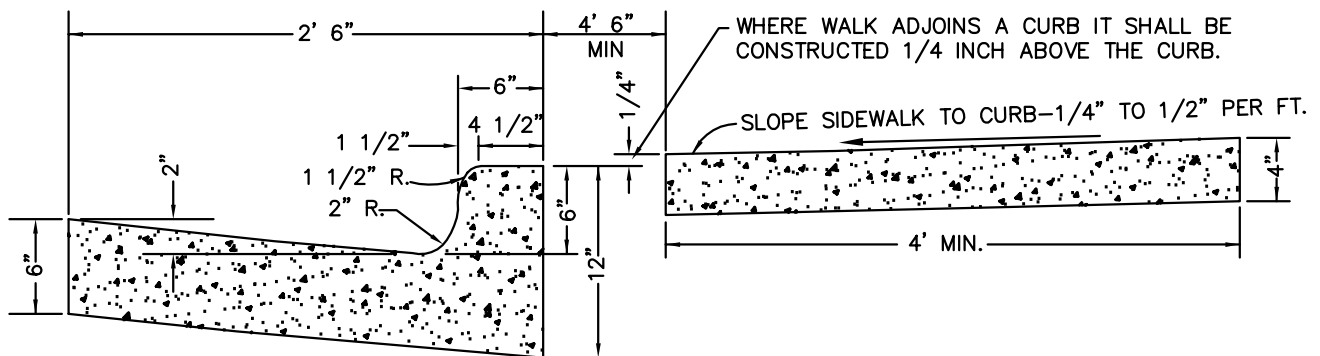
**CROSS PAN
 DETAIL**

APPROVED BY: MAYOR

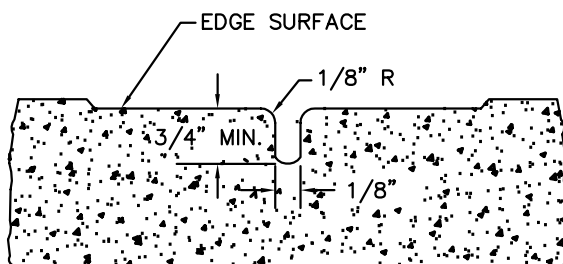
TST



DRIVE-OVER CURB, GUTTER AND SIDEWALK
N.T.S.

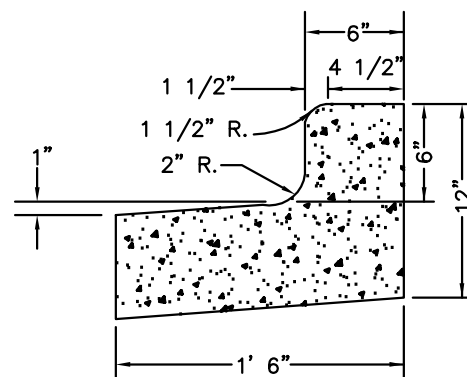


VERTICAL 6 INCH CURB, GUTTER AND SIDEWALK
N.T.S.



NOTE: JOINT SHALL BE CUT
1/4 THICKNESS OF
CONCRETE INITIALLY

DUMMY JOINT FOR WALKS
N.T.S.



OUTFALL CURB AND GUTTER
N.T.S.

CURB AND GUTTER DETAILS

**TOWN OF
FIRESTONE**

**CURB, GUTTER AND
SIDEWALK DETAIL**

APPROVED BY: MAYOR

TST

NOTES

1. RAMP LANDING SHALL BE CONCRETE COLORED WITH 4 LBS./SACK DAVIS NO. 1117 (TILE RED) PIGMENT OR APPROVED EQUAL. DAVIS CLEAR SEALANT OR APPROVED EQUAL SHALL BE APPLIED ON ALL COLORED CONCRETE SURFACES.

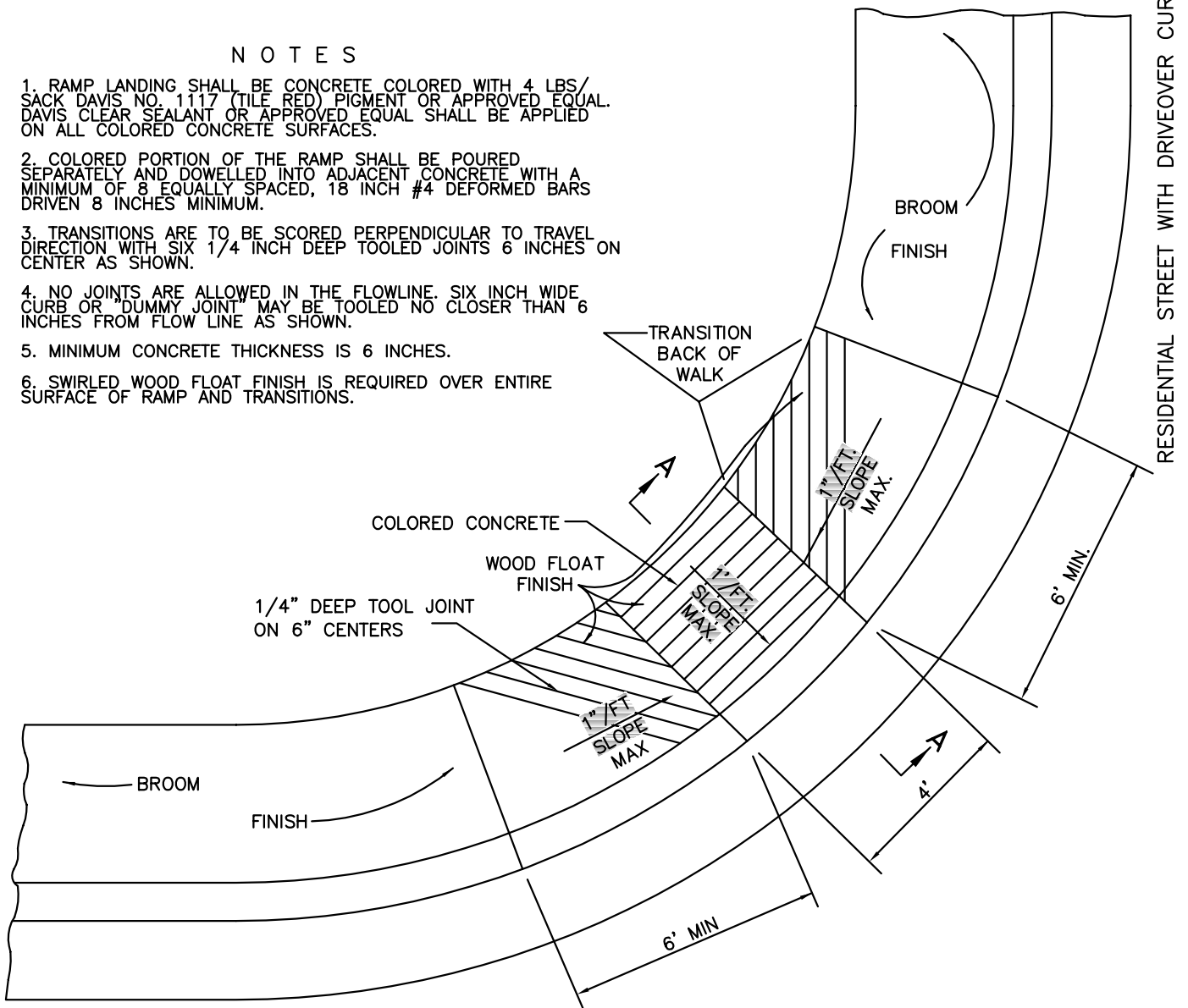
2. COLORED PORTION OF THE RAMP SHALL BE POURED SEPARATELY AND DOWELLED INTO ADJACENT CONCRETE WITH A MINIMUM OF 8 EQUALLY SPACED, 18 INCH #4 DEFORMED BARS DRIVEN 8 INCHES MINIMUM.

3. TRANSITIONS ARE TO BE SCORED PERPENDICULAR TO TRAVEL DIRECTION WITH SIX 1/4 INCH DEEP TOOLED JOINTS 6 INCHES ON CENTER AS SHOWN.

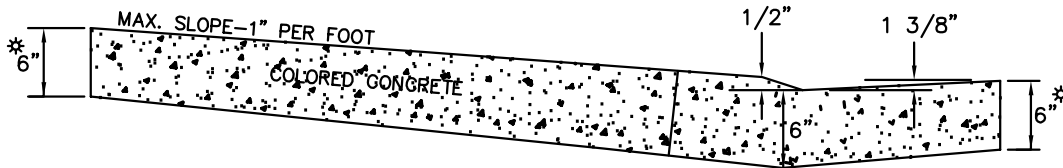
4. NO JOINTS ARE ALLOWED IN THE FLOWLINE. SIX INCH WIDE CURB OR "DUMMY JOINT" MAY BE TOOLED NO CLOSER THAN 6 INCHES FROM FLOW LINE AS SHOWN.

5. MINIMUM CONCRETE THICKNESS IS 6 INCHES.

6. SWIRLED WOOD FLOAT FINISH IS REQUIRED OVER ENTIRE SURFACE OF RAMP AND TRANSITIONS.



RESIDENTIAL STREET WITH DRIVEOVER CURB



SECTION A-A
N.T.S.

*6" DEPTH APPLIES FOR ENTIRE CURB RETURN AREA (PC TO PC)

ACCESS RAMP DETAIL

*TOWN OF
FIRESTONE*

*HANDICAPPED
RAMP DETAIL*

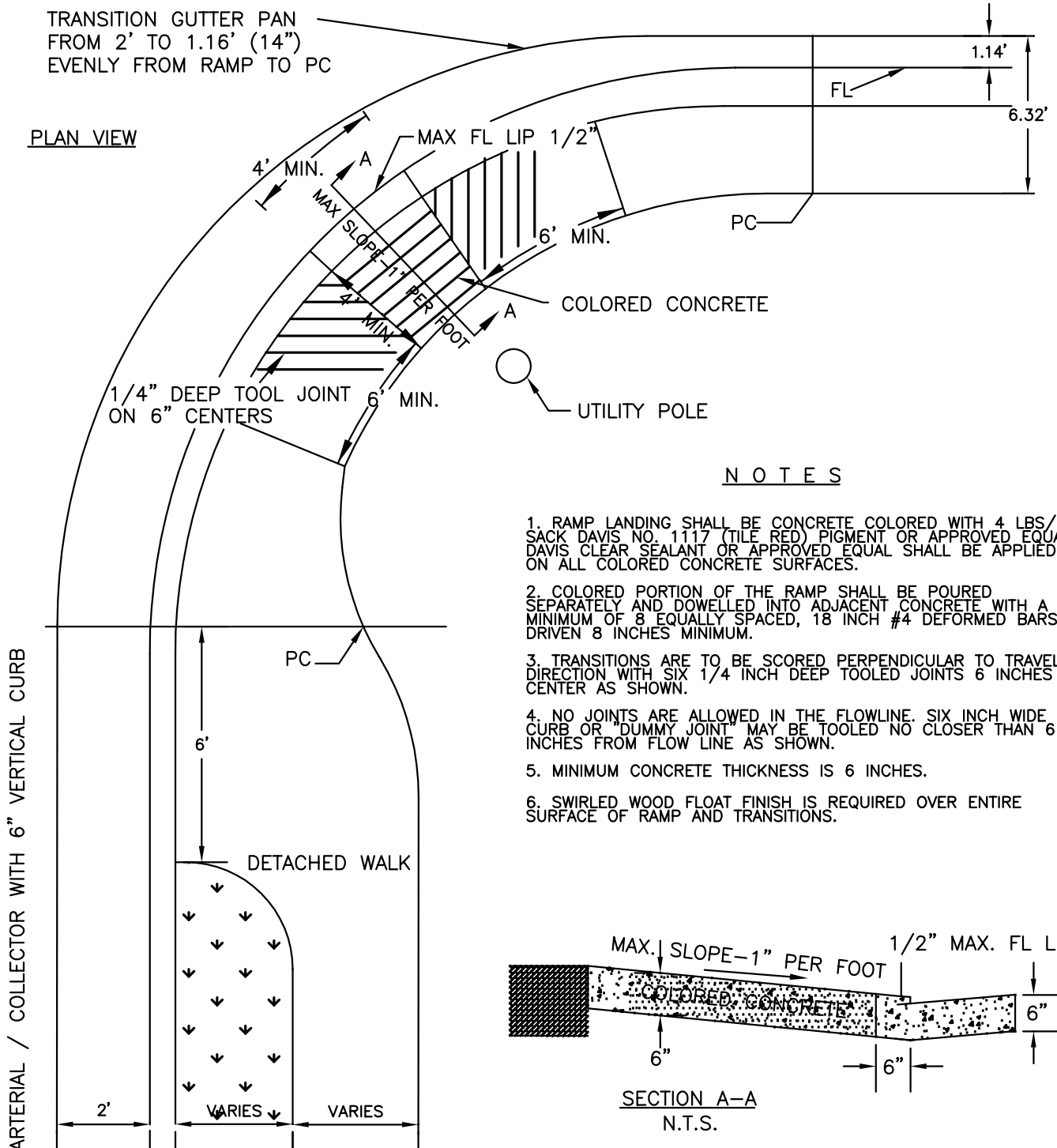
APPROVED BY: MAYOR

TST

RESIDENTIAL STREET WITH DRIVEOVER CURB

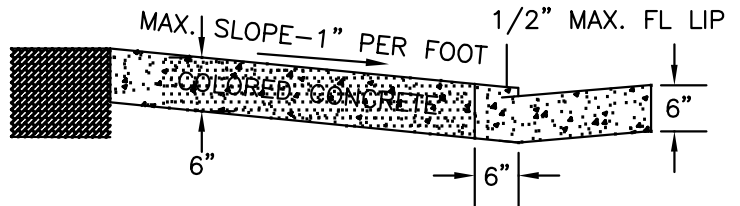
TRANSITION GUTTER PAN
FROM 2' TO 1.16' (14")
EVENLY FROM RAMP TO PC

PLAN VIEW



NOTES

1. RAMP LANDING SHALL BE CONCRETE COLORED WITH 4 LBS/ SACK DAVIS NO. 1117 (TILE RED) PIGMENT OR APPROVED EQUAL. DAVIS CLEAR SEALANT OR APPROVED EQUAL SHALL BE APPLIED ON ALL COLORED CONCRETE SURFACES.
2. COLORED PORTION OF THE RAMP SHALL BE POURED SEPARATELY AND DOWELLED INTO ADJACENT CONCRETE WITH A MINIMUM OF 8 EQUALLY SPACED, 18 INCH #4 DEFORMED BARS DRIVEN 8 INCHES MINIMUM.
3. TRANSITIONS ARE TO BE SCORED PERPENDICULAR TO TRAVEL DIRECTION WITH SIX 1/4 INCH DEEP TOOLED JOINTS 6 INCHES ON CENTER AS SHOWN.
4. NO JOINTS ARE ALLOWED IN THE FLOWLINE. SIX INCH WIDE CURB OR "DUMMY JOINT" MAY BE TOOLED NO CLOSER THAN 6 INCHES FROM FLOW LINE AS SHOWN.
5. MINIMUM CONCRETE THICKNESS IS 6 INCHES.
6. SWIRLED WOOD FLOAT FINISH IS REQUIRED OVER ENTIRE SURFACE OF RAMP AND TRANSITIONS.



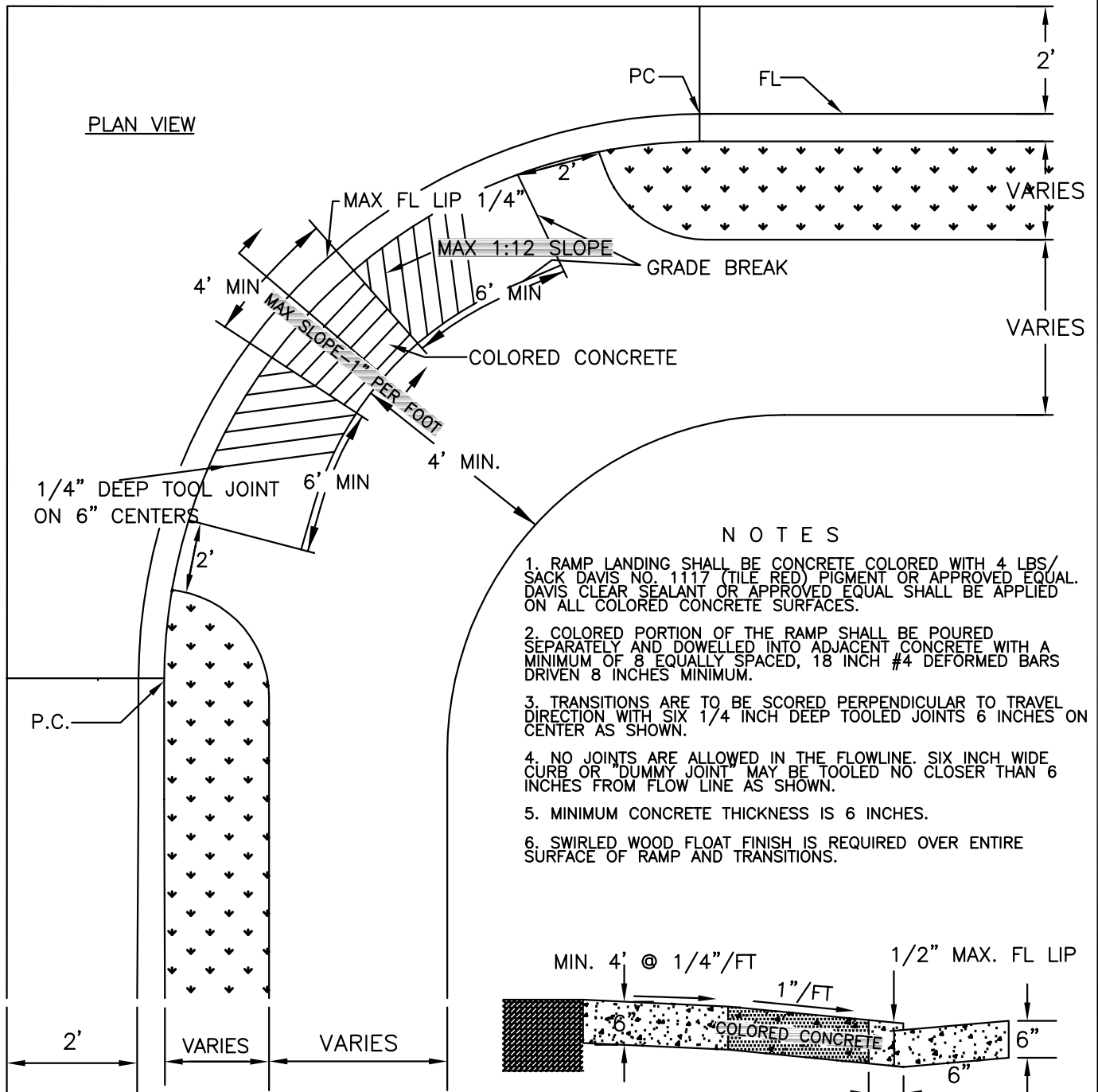
*TOWN OF
FIRESTONE*

*HANDICAPPED
RAMP DETAIL*

APPROVED BY: MAYOR

TST

ARTERIAL / COLLECTOR WITH 6" VERTICAL CURB



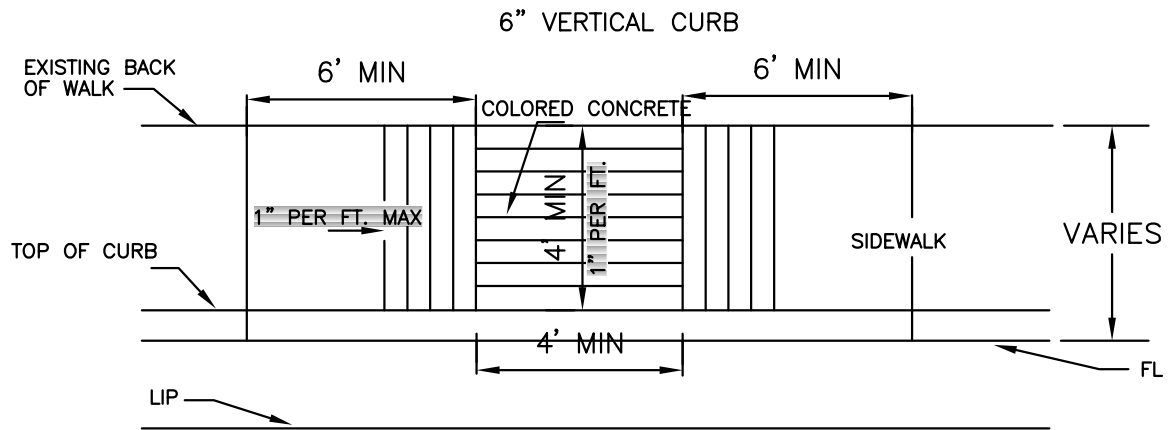
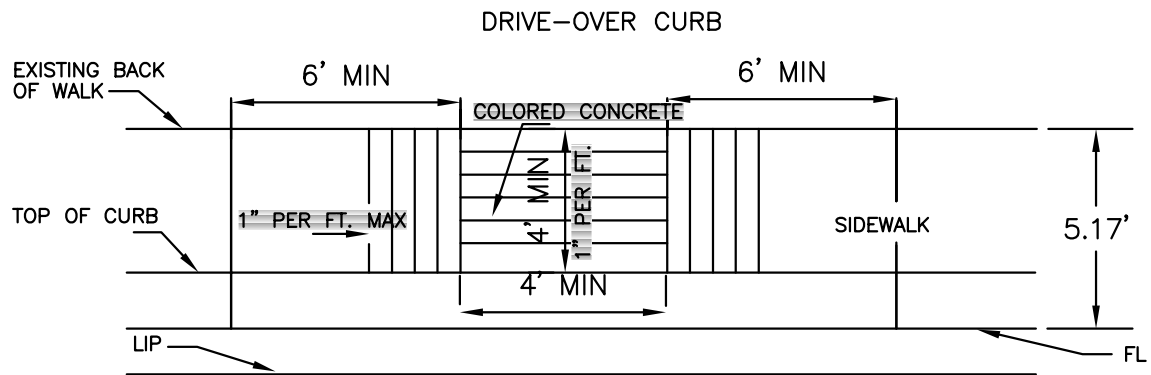
SECTION A-A
N.T.S.

*TOWN OF
FIRESTONE*

HANDICAPPED RAMP DETAIL

APPROVED BY: MAYOR

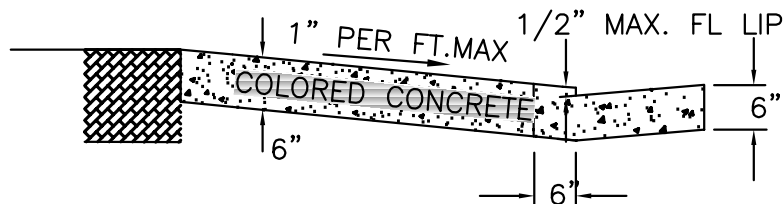
TST



NOTES

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2. COLORED PORTION OF THE RAMP SHALL BE POURED SEPARATELY AND DOWELLED INTO ADJACENT CONCRETE WITH A MINIMUM OF 8 EQUALLY SPACED, 18 INCH #4 DEFORMED BARS DRIVEN 8 INCHES MINIMUM.
3. TRANSITIONS ARE TO BE SCORED PERPENDICULAR TO TRAVEL DIRECTION WITH SIX 1/4 INCH DEEP TOOLED JOINTS 6 INCHES ON CENTER AS SHOWN.

4. NO JOINTS ARE ALLOWED IN THE FLOWLINE. SIX INCH WIDE CURB OR "DUMMY JOINT" MAY BE TOOLED NO CLOSER THAN 6 INCHES FROM FLOW LINE AS SHOWN.
5. MINIMUM CONCRETE THICKNESS IS 6 INCHES.
6. SWIRLED WOOD FLOAT FINISH IS REQUIRED OVER ENTIRE SURFACE OF RAMP AND TRANSITIONS.



TYPICAL RAMP CROSS-SECTION

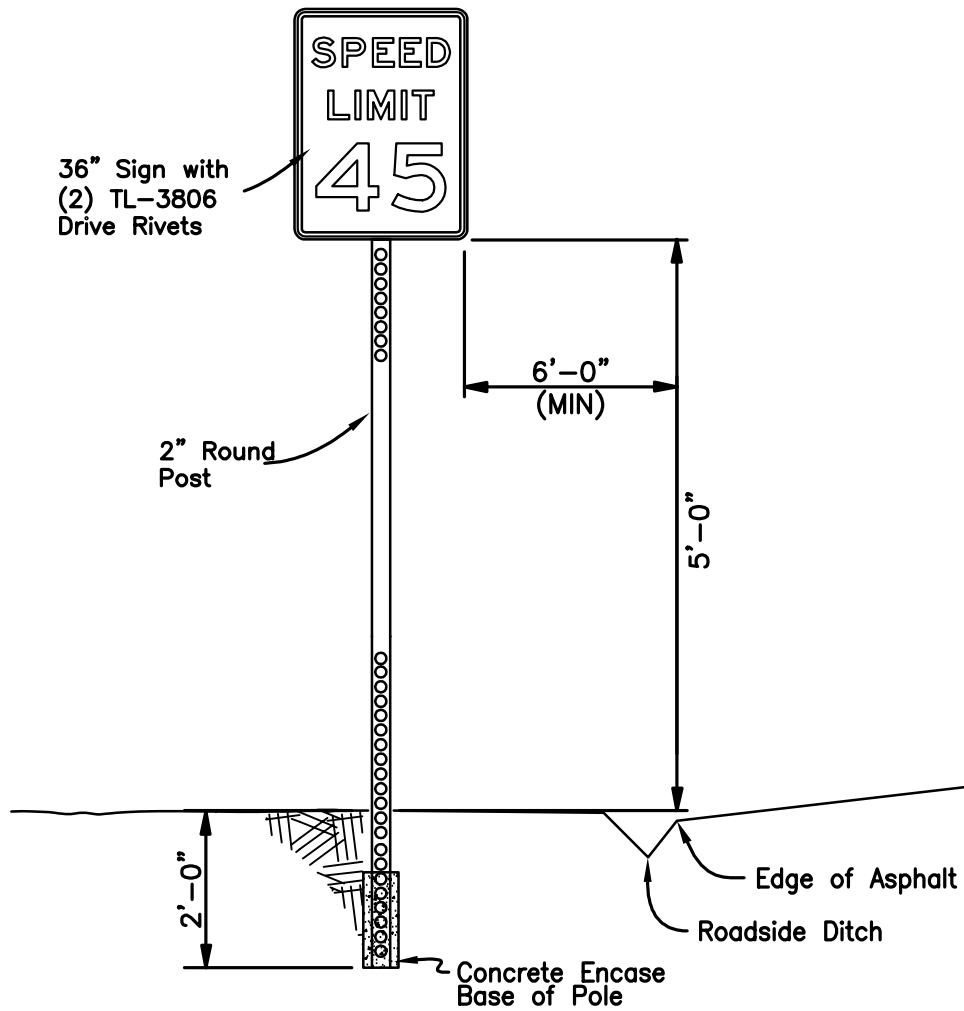
N.T.S.

*TOWN OF
FIRESTONE*

*MIDBLOCK
HANDICAPPED
RAMP DETAIL*

APPROVED BY: MAYOR

TST



NOTES:

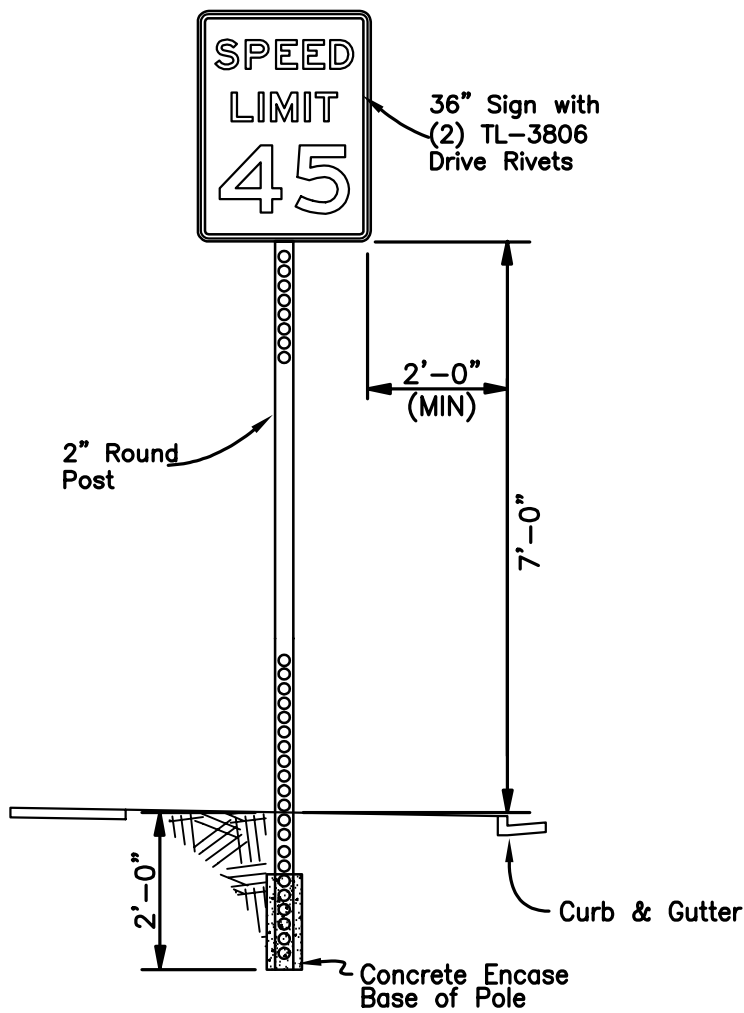
1. Attach the sign panels tightly to the post and use oversized washers to keep the sign from breaking loose from the post if hit by a vehicle.
2. Sign panels should be mounted a minimum of 5 feet above the pavement or ground.
3. Signs larger than 36 inches in length or width require wind bracing and special post design.

*TOWN OF
FIRESTONE*

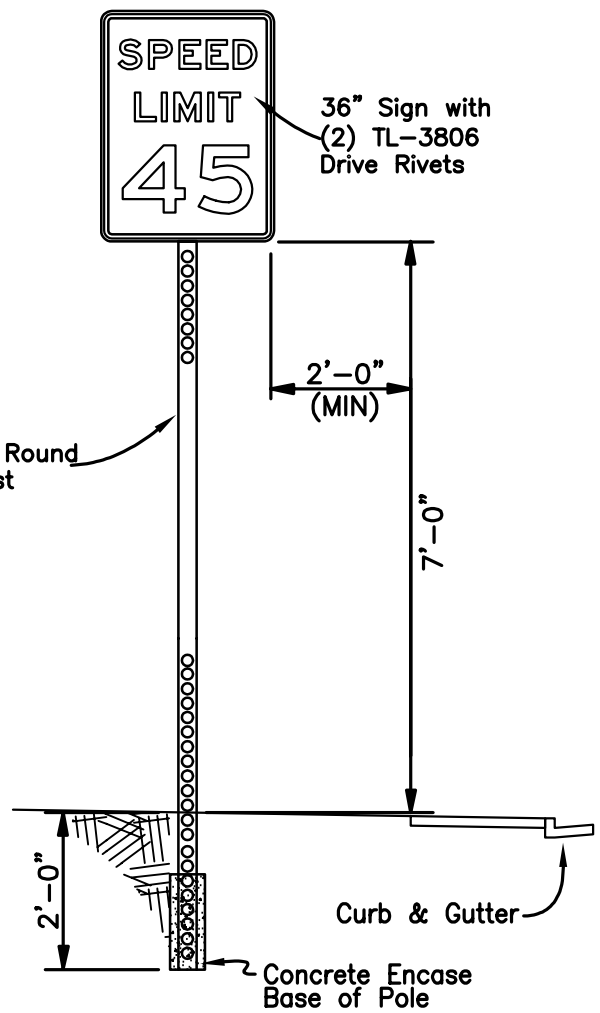
*SIGN POST DETAIL
RURAL STREETS*

APPROVED BY: MAYOR

TST



DETACHED WALK



ATTACHED WALK

NOTES:

1. Attach the sign panels tightly to the post and use oversized washers to keep the sign from breaking loose from the post if hit by a vehicle.
2. Sign panels should be mounted a minimum of 7 feet above the pavement or ground.
3. Signs larger than 36 inches in length or width require wind bracing and special post design.

*TOWN OF
FIRESTONE*

*SIGN POST DETAIL
RESIDENTIAL STREETS*

APPROVED BY: MAYOR

TST